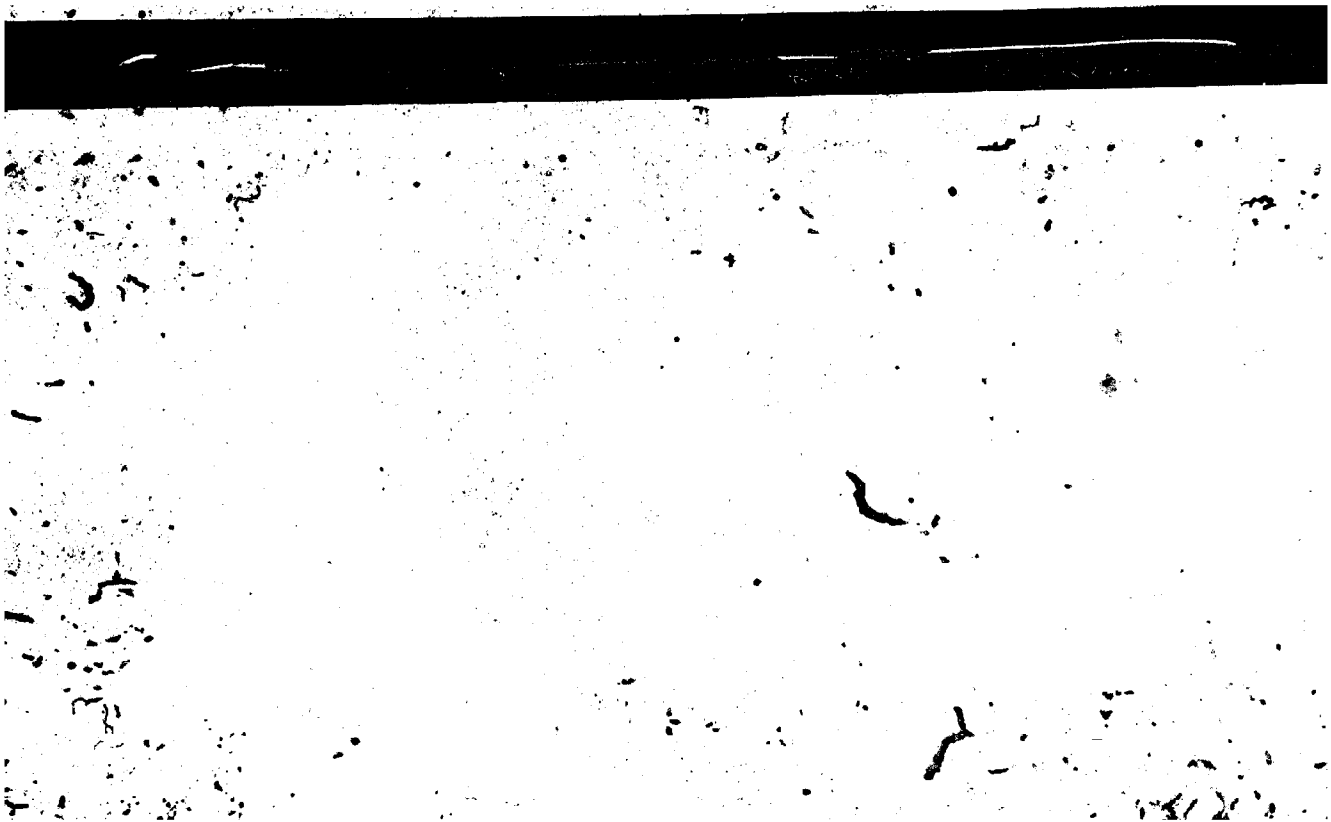

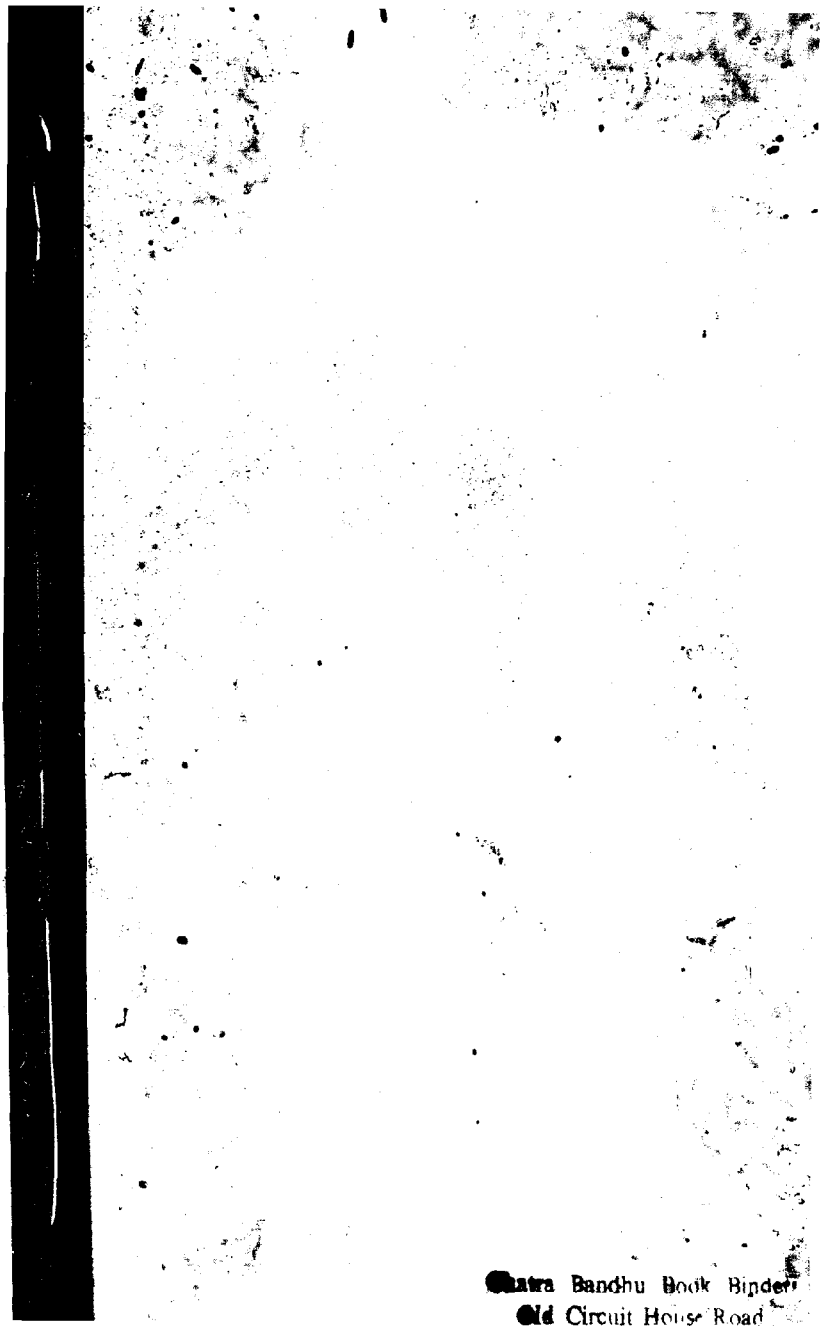

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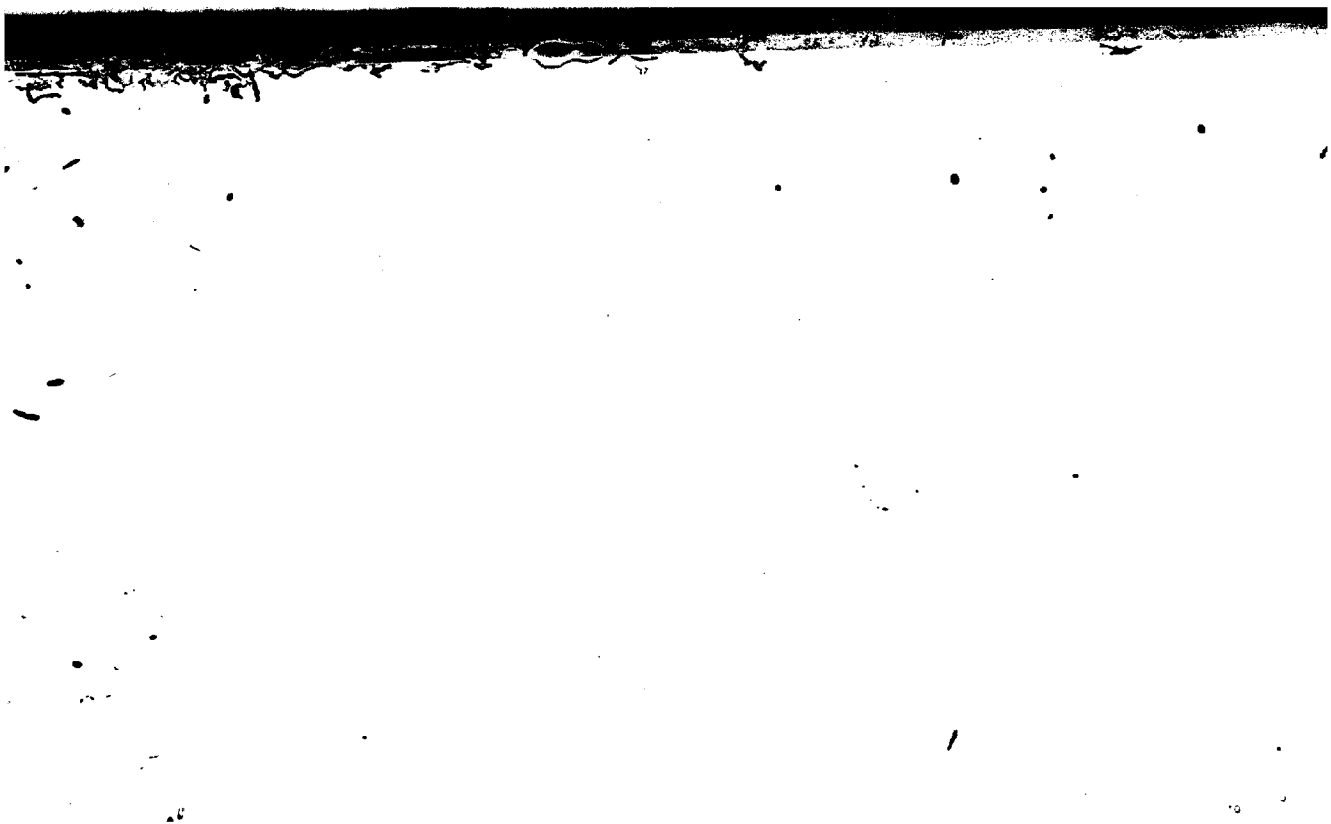
Old Circuit House Road



BULLETIN OF THE IMPERIAL INSTITUTE

QUARTERLY RECORD OF PROGRESS IN TROPICAL AGRICULTURE AND INDUSTRIES AND THE COMMERCIAL UTILISATION OF THE NATURAL RESOURCES OF THE DOMINIONS, COLONIES AND INDIA

EDITED BY THE DIRECTOR AND PREPARED BY THE SCIENTIFIC AND TECHNICAL STAFF OF THE IMPERIAL INSTITUTE AND BY OTHER CONTRIBUTORS

VOL. XVI 1918

LONDON
JOHN MURRAY, ALBEMARLE STREET, W.

ERRATA

Page 39, line 13, for *P. Mobola*, Olio. read *P. Mobola*, Oliv.

Page 392, line 13 from bottom, for *Haematoxylon brasilete* read *Haematoxylon Brasiletto.*

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BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XVI. 1918

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REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

The following summaries have been prepared from a selection of the Reports made by the Director of the Imperial Institute to the Dominion, Colonial and Indian Governments.

SOUTH AFRICAN GRASSES FOR PAPER-MAKING

BEFORE the war the British Empire depended to a large extent on foreign countries for supplies of paper and the wood-pulp from which paper was largely made, the chief sources of supply of the latter being Scandinavia, though some was obtained from Newfoundland and Canada. It has long been realised that the tropical countries of the Empire possess in their coarse grasses abundant raw material for the manufacture of paper, and special attention has been given in India to the problem of utilising these grasses in this way. Interest in this subject has extended to other countries of the Empire since the war began, and the scarcity of tonnage has put serious difficulties in the way of importing either paper or pulp.

In South Africa a great deal of attention has been given to the subject recently, and as a result a number of grasses have been sent to the Imperial Institute from South Africa for trial as paper-materials. A selection of the reports on these grasses is now published.

JOHNSON GRASS

A sample of Johnson Grass (*Sorghum halepense*) was received in May 1917. It consisted of reed-like stems of pale green to straw tint, measuring from 7 to 8 ft.

in length ; the stems were about $\frac{3}{8}$ in. in diameter at the base, tapering to about $\frac{1}{8}$ in. at the top and bearing a flowering head. The stems were hollow but had solid nodes at intervals of about 1 ft., each node bearing a sheathing leaf of pale green or straw colour, often blotched with purple ; the internodes were filled with soft white pith.

The grass was submitted to chemical examination with the following results :

	Per cent.	
Moisture	10·3	
Ash	7·4	Expressed on the dry grass.
Cellulose	52·5	

The ultimate fibres were from 0·5 to 1·7 mm. in length, mostly measuring from 0·7 to 1·1 mm.

The chopped grass was treated with caustic soda solution under conditions similar to those employed for the production of paper pulp on a large scale, with the following results :

Experiment.	Caustic soda used.		Conditions of boiling.		Soda consumption.	Yield of dry pulp expressed on the grass as received.
	Parts per 100 parts of solution.	Parts per 100 parts of grass.	Time.	Temperature.		
			Hours.		*Per cent.*	*Per cent.*
A	4	12	4	140° C.	10·5	50
B	4	16	4	140° C.	11·0	48
C	4	20	4	140° C.	12·0	45

The pulp obtained in each of the three experiments shrank very considerably on drying, and yielded a tough, semi-transparent, parchment-like paper, on account of the presence of a large amount of pith in the pulp. The pulp prepared in experiment A was dark-coloured and somewhat hard to beat, and could not be bleached even with more bleaching powder than could be used economically on a large scale. The use of a larger quantity of caustic soda for boiling (16 per cent.) yielded a pulp of better colour, which was easy to beat, but which only bleached to a dark cream colour even with an excessive quantity of bleaching powder.

The more drastic conditions of Experiment C did

not appreciably improve the colour or bleaching properties of the pulp.

This grass gives a good yield of pulp, but is nevertheless not very promising as a paper-making material. The pulp contains a large amount of parenchyma derived from the pith, and this causes the paper to shrink greatly in drying, and renders it parchment-like. The pulp, moreover, does not bleach well.

It might be possible to utilise the grass for the manufacture of paper in South Africa, but if used by itself the pulp would probably be troublesome to work on account of the great shrinkage on drying, and as it does not bleach easily its principal use would probably be for the manufacture of wrapping-papers. The nature of the pulp might, however, render it valuable for the production of special kinds of parchment-like papers, either by itself or in admixture with other fibrous materials.

Thatching Grass (Dek Gras)

A sample of "thatching grass," or "Dek Gras," which was identified at Kew as *Andropogon Buchananii*, Stapf, was received in June 1917.

It consisted of tapering stems, varying from 4 ft. to 5 ft. 6 in. in length, but mostly about 4 ft. 6 in., and each bearing a flowering head. The stems were $\frac{1}{16}$ in. to $\frac{3}{16}$ in. in diameter at the base, and had nodes at intervals of 10 to 15 in. throughout their length, a sheathing leaf springing from each node. The internodes were filled with soft pith.

On examination the grass was found to contain:

	Per cent.	
Moisture	10·1	
Ash	6·3	Expressed on the dry grass.
Cellulose	53·8	

Length of ultimate fibres 1·0 to 4·0 mm.; mostly 1·5 to 2·5 mm.

The grass was submitted to treatment with varying quantities of caustic soda, under conditions similar to those used for the production of paper pulp on a large scale, with the following results:

Experiment.	Caustic soda used.		Conditions of boiling.		Soda consumption.	Yield of dry pulp expressed on the grass as received.
	Parts per 100 parts of grass.	Parts per 100 parts of solution.	Time.	Temperature.		
			Hours.		*Per cent.*	*Per cent.*
A	10	2·5	5½	140° C.	8·0	52
B	12	3·0	4½	140° C.	8·4	51
C	16	4·0	4½	140° C.	10·0	48
D	20	4·0	4½	140° C.	11·4	46

The pulps obtained in experiments A and B were of pale brown colour. The pulp from experiment A could not be bleached, whilst that obtained in experiment B bleached only to a cream colour. In both these experiments the nodes of the grass remained somewhat hard after the treatment, and caused a little difficulty in the beating process.

The more drastic treatment employed in experiments C and D yielded pulps of paler colour and better quality. No difficulty was experienced in beating these pulps, and they bleached easily to a pale cream colour (almost white) when treated with 10 to 15 per cent. of their dry weight of bleaching powder.

In all cases the pulps furnished an opaque paper of good strength and quality, which did not shrink appreciably on drying.

This grass appears to be a promising material for the manufacture of paper in South Africa, as it gives a satisfactory yield of long-fibred pulp of good quality, suitable in the unbleached state for the manufacture of strong brown paper, or after bleaching for the manufacture of fairly good cream-coloured or white paper.

The export of the grass from South Africa would scarcely be feasible, as it would probably only have about the same value as Algerian esparto, *i.e.* £3 to £3 10s. per ton in the United Kingdom in normal times. It may, however, be possible to convert the grass into "half-stuff" or paper in South Africa for export.

Tambookie Grasses

According to Dr. C. F. Juritz (*South African Journal of Industries*, 1918, **1**, 516) the term "tambookie" or "mbuki" includes a large number of grasses belonging

to the related genera *Cymbopogon* and *Andropogon*. In 1914 a sample of "tambookie" grass, stated to be *Cymbopogon Nardus* var. *vallidus*, was forwarded to the Imperial Institute in order to ascertain its value for paper-making (see this BULLETIN, 1916, **14**, 163). In June 1917 two further samples of distinct grasses were received, both described as tambookie grass. These samples were numbered 3 and 4. It was stated that No. 3 grows plentifully in dry open situations round Pretoria, and that No. 4 is abundant in damp situations in the same area.

Specimens of the two grasses were submitted to Kew for identification, with the result that No. 3 was pronounced to be *Andropogon Dregeanus*, Nees, and No. 4 *Andropogon auctus*, Stapf.

The two grasses were very similar in general appearance, consisting of long tapering golden-yellow stems measuring up to $\frac{3}{16}$ in. in diameter at the base, with nodes at intervals of about 10 in., the internodes being filled with soft pith. Each node bore a sheathing leaf and each stem was terminated by a long flowering head, which in sample No. 3 was mostly reddish in colour and in No. 4 greenish.

The length of the grass in sample No. 3 was 4 to 6 ft., and 5 to 7 ft. in sample No. 4.

The samples were submitted to chemical examination with the following results:

	No. 3. *Per cent.*	No. 4. *Per cent.*	
Moisture	9·2	9·1	
Ash	4·5	7·1	Expressed on the dry grass.
Cellulose	47·4	53·5	
Percentage of silica (SiO_2) in the ash	54·0	63·8	

The length of the ultimate fibres in sample No. 3 was from 0·3 to 3·8 mm., and in sample No. 4 from 0·3 to 3·9 mm., being mostly from 1 to 2 mm. in both cases.

The samples were examined as paper-making materials by treatment with varying quantities of caustic soda under conditions similar to those used in the production of paper pulp on a large scale, and the results are shown in the following table:

Experiment.	Percentage of caustic soda used; expressed on the grass as received.[1]	Boiled at 140° C. for	Yield of dry pulp expressed on grass as received.		Parts of caustic soda consumed per 100 parts of grass.	
			No. 3.	No. 4.	No. 3.	No. 4.
		Hours.	*Per cent.*	*Per cent.*		
A	10	5	50	—	8·8	—
B	12	5	—	52	—	10
C	16	4	45(approx.)	—	11·2	—
		5	—	50	—	10
D	20	4	40	—	15	—
		5	—	42	—	11·8

[1] *In all the experiments a 4 per cent. solution of caustic soda was used.*

Sample No. 4 (*Andropogon auctus*) therefore contained more cellulose and gave a higher yield of pulp than sample No. 3 (*A. Dregeanus*). Both samples, however, gave good yields of unbleached pulp, which produced tough, strong papers of good quality. The use of about 20 per cent. of caustic soda was necessary to produce a pulp capable of being bleached to a good white colour, though pulp bleaching to a fairly good colour was obtained with only 16 per cent. of caustic soda. The pulps produced in experiments A and B were of brown colour and could not be bleached.

In the preceding experiments the entire grass was used in the preparation of the pulp, and in practically all cases the pulp contained numerous small dark specks which detracted from the appearance of the paper. The following further experiments were therefore carried out with sample No. 3 in order to ascertain if possible the reason for the presence of these specks:

Experiment.	Material used: No. 3.	Percentage of caustic soda used; expressed on grass as received.[1]	Conditions of boiling.		Yield of dry pulp expressed on the air-dry material.	Caustic soda consumed per 100 parts of material.
			Time.	Temperature.		
			Hours		*Per cent.*	
E	Grass with flowering heads removed	16	5	140° C.	49	12
F	Grass with flowering heads and sheathing leaves removed	16	5	140° C.	52	11·6
G	Entire grass, with nodes crushed	16	5	140° C.	46	12·2

[1] *In all the experiments a 4 per cent. solution of caustic soda was used.*

The pulps produced in these experiments still contained small specks, and it would therefore appear that the specks are not due either to the inclusion of the flowering heads or leaves or to the incomplete disintegration of the nodes, but that they are accounted for by the impossibility of avoiding or removing small imperfectly beaten masses of fibre during treatment in the experimental apparatus used in the laboratory. The specks could probably be obviated in the preparation of the pulp on a manufacturing scale.

It was found that the removal of the flowering heads from the grass gives an unbleached paper of rather superior colour and character to that prepared from the entire grass, whilst the removal of both flowering heads and leaves gives a pale unbleached pulp of very good quality, bleaching to a satisfactory colour. On a commercial scale the removal of the leaves and flowers from the grass could probably be effected by chopping up the grass and winnowing out the lighter leaves and flowers.

The present samples of Tambookie grass both yielded pulp of good quality, and good brown papers could be made from them by treatment with small amounts of caustic soda (10 per cent. or probably less on a large scale). The pulps obtained with larger proportions of caustic soda could be readily bleached and used for the manufacture of white paper of good quality.

Andropogon hirtiflorus

A sample of *Andropogon hirtiflorus* grass was received in June 1917. It consisted of dark straw-coloured stems measuring up to $\frac{1}{8}$ in. in diameter and about 3 ft. in length. The stems had nodes at intervals of about 10 to 12 in., and bore flowering heads of a reddish colour. The internodes were filled with soft pith.

Specimens of the grass were submitted to Kew for identification, with the result that the plant was pronounced to be *A. hirtiflorus* var. *semiberbis*, Stapf.

The grass was submitted to chemical examinat on with the following results :

	Per cent.	
Moisture	8·7	
Ash[1]	3·8	Expressed on the dry grass
Cellulose	55·8	

[1] *Containing* 39·1 *per cent of silica* (SiO_2).

Length of ultimate fibres 0·4 to 1·2 mm., mostly 0·6 to 0·7 mm.

The grass was examined as a paper-making material by treatment with varying amounts of caustic soda under conditions similar to those used on a commercial scale for the manufacture of paper pulp, and the results are shown in the following table:

Experiment.	Caustic soda used.		Conditions of boiling.		Parts of caustic soda consumed by 100 parts of grass.	Yield of dry pulp expressed on the grass as received.
	Parts per 100 parts of grass.	Parts per 100 parts of solution.	Time.	Temperature.		
			Hours.			*Per cent.*
B	12	4	6	140° C.	9·4	54
C	16	4	4½	140° C.	9·6	54
D	20	4	4½	140° C.	12·8	50

These results show that the grass gives a good yield of pulp, but the ultimate fibres are short and the paper produced is somewhat inferior in strength to that yielded by the "Dek Gras" or the Tambookie grasses dealt with on pp. 129 and 130. The unbleached pulps are inferior in colour to those obtained from the latter grasses, but they can be bleached to a good colour.

There is no doubt that this *A. hirtiflorus* grass would be quite suitable for the manufacture of paper pulp on a commercial scale.

THE WASTE PULP FROM NEW ZEALAND HEMP

In the preparation of the fibre from the leaves of the New Zealand hemp plant (*Phormium tenax*), a large amount of waste pulp is produced, which hitherto has not been put to commercial use. In order to produce 1 ton of fibre, about 7 to 8 tons of leaves are necessary, and as the production of fibre in New Zealand alone amounts on the average to over 20,000 tons each year, it will be seen that if a use could be found for the waste material

it would add considerably to the success of the industry. The importance of this subject is recognised by the New Zealand Government, who have offered a bonus for a process for utilising the pulp and other waste products.

New Zealand hemp is also grown, on a smaller scale, in St. Helena, and, with a view to finding some means of utilising the waste pulp, two samples from that island were forwarded recently to the Imperial Institute. They were as follows :

A. " Rotted pulp two months in heap, temperature 110° when taken out. Dried in the sun before putting into sack." Weight, 56 lb.

The material was a coarse, dark brown powder, containing some short fibre.

B. " Fresh pulp sun-dried before placing in sack." Weight, 46 lb.

This was similar to A, but was much lighter in colour.

The two pulps were investigated : (1) as possible paper-making materials, and (2) as manures and sources of potash.

(1) *Possible Use as Paper-making Material*

The samples were submitted to a preliminary chemical examination in order to ascertain whether the material was likely to be of any value for the manufacture of paper pulp, and the following results were obtained :

	A (Rotted). *Per cent.*	B (Sun-dried). *Per cent.*
Moisture, on drying at 100° C.	8·9	8·3
Cellulose in the dried pulp	37·4	31·8

The rotted pulp therefore contained more cellulose than the sun-dried pulp, probably owing to the removal of non-cellulose constituents in the rotting process, but the percentage in both samples was low. The cellulose moreover was of poor quality, consisting largely of short, thin-walled (parenchymatous) cells which are of no value for paper-making.

This Phormium pulp in the condition of the present samples would be of no commercial value as a paper-making material. The small amount of fibre present (from 2·5 to 3 per cent.) could no doubt be utilised for the manufacture of paper pulp if separated from the

pithy matter by sifting; but it seems unlikely that the yield or the value of the product would be sufficient to cover the cost of production and transport. The product would have to compete with common waste materials such as old sacking, rope, etc., which are obtained in ordinary times at low prices.

On the whole, therefore, the possibility of utilising this Phormium waste as a paper-making material does not appear promising.

(2) *Use as Manure and Source of Potash*

The composition of the pulp was investigated in order to ascertain its manurial value and the possibility of utilising it as a source of potash salts. The results are given in the following table, in comparison with corresponding figures for stable manure:

		Sample A. (Rotted.)	Sample B. (Sun-dried.)	Fresh long straw stable manure.
		Per cent.	*Per cent.*	*Per cent.*
Moisture, on drying at 100° C.		8·9	8·3	66·17
Nitrogen		1·07 [1]	1·00 [1]	0·54 [1]
Ash (total)		18·5	11·1	—
Ash soluble in cold water		—	5·2	—
Potash	K_2O	3·93 [1]	2·93 [1]	0·67 [1]
Phosphoric acid	P_2O_5	0·40 [1]	0·34 [1]	0·32 [1]
Nitrogen	N	1·17	1·09	1·61
Potash	K_2O	4·31	3·19	1·99
Phosphoric acid	P_2O_5	0·44	0·37	0·94
The ash contained:				
Lime	CaO	—	9·35	—
Magnesia	MgO	—	5·27	—
Potash (total)	K_2O	21·24	26·40	—
Potash soluble in cold water	K_2O	—	21·74	—
Soda	Na_2O	6·26	7·98	—
Sulphuric acid	SO_3	—	1·36	—
Chlorine	Cl	—	6·81	—
Phosphoric acid	P_2O_5	—	2·93	—
Carbon dioxide	CO_2	—	10·70	—
Total matter soluble in cold water		—	46·80	—
The soluble matter in the ash contained:				
Potash	K_2O	—	46·45	—
Soda	Na_2O	—	12·93	—
Sulphuric acid	SO_3	—	3·33	—
Chlorine	Cl	—	6·47	—
Carbon dioxide	CO_2	—	24·59	—

[1] *Expressed on the dry materials, the percentages of these constituents are as follows:*

The results of the chemical examination show that the pulp would have a considerable manurial value on account of the nitrogen, potash and phosphoric acid it contains. The amounts of nitrogen and phosphoric acid do not differ much in the samples of rotted and sun-dried pulp, but the rotted material contains a larger percentage of potash. Comparing the pulp with fresh long-straw stable manure, it will be seen that for equal weights the sun-dried or rotted pulp, as represented by these samples, contains about twice as much nitrogen as the stable manure, about as much phosphoric acid, and from 5 to 6 times as much potash. If the pulp were used in a wet condition, the percentages of the manurial constituents would of course be correspondingly reduced.

In this connection it may be mentioned that experiments were conducted some years ago at various Government Experiment Farms in New Zealand, with a view to ascertaining the value of Phormium refuse as a manure for potatoes and mangels (*Journ. Agric., New Zealand*, 1910, **1**, 276; 1913, **6**, 16). In one set of trials, on a clay soil, potatoes were manured with the refuse at the rate of 20 tons and 30 tons per acre. In both cases the plants grew more quickly than when artificial manures alone were used. The plot manured at the rate of 20 tons per acre gave a crop of good quality, but not equal to that given by 2 cwts. of superphosphate, whilst the more heavily manured plot gave better results, being quite equal to the best of those treated with artificial manures. In a second trial with potatoes, on a sandy soil, a plot manured with Phormium waste at the rate of 20 tons per acre gave an increase of 2 tons 7 cwts. per acre over an unmanured plot, the increased yield obtained by manuring with 2 cwts. superphosphate, 2 cwts. basic slag, 1½ cwts. dried blood, and 1 cwt. muriate of potash per acre, being 2 tons 10 cwts.; the best result in this series of trials, viz. an increased yield of 4 tons 1 cwt. per acre, was obtained by using 2 cwts. superphosphate, 1½ cwts. bone-dust, ¾ cwt. sulphate of ammonia, 1 cwt. muriate of potash and 1 cwt. ferrous sulphate per acre. In a single set of experiments with mangels, Phormium refuse alone, at the rate of 56 cwts. per acre, did not give

favourable results, the yield being little better than on an unmanured plot, but in combination with superphosphate, at the rate of 2½ cwts. of the latter and 28 cwts. of the waste per acre, excellent results were obtained, this plot taking second place in a trial with 22 different mixtures of artificial manures.

Instead of using the pulp itself as a manure, it could be burnt and the ash applied to the soil. On the basis of the results given on p. 136, 1 ton of the sun-dried waste represented by sample B would yield on burning 248 lb. of total ash containing 65 lb. of potash (K_2O), and 54 lb. of the potash would be soluble in water. The ash would therefore form a valuable potash manure; but, as it also contains a fairly large percentage of soda in the form of sodium carbonate, care would have to be exercised in applying it to plants particularly sensitive to the action of the latter salt.

The analysis of the portion of the ash soluble in water shows that it compares favourably in composition with commercial "potashes," but the separation of the potassium carbonate from the mixed soluble salts is not an operation which can be carried out successfully on a small scale.

With reference to the burning of the pulp for the production of the ash, it was found in small-scale trials at the Imperial Institute that the sun-dried pulp burns slowly and holds fire well, so that it could probably be burnt successfully in heaps. It might, however, be possible to burn the sun-dried pulp in the furnaces at the fibre-extracting mills if the light powdery nature of the material does not create difficulties. Experiments at the Imperial Institute showed that the heating value of the sun-dried pulp is about 45 per cent. of that of good steam coal.

ERI SILK FROM THE EAST AFRICA PROTECTORATE

ERI silk is obtained from the cocoons of an Indian moth, *Attacus ricini*, the caterpillar of which is reared for the production of silk in Assam, and to a smaller extent in certain parts of Bengal and Northern India. This silk cannot be reeled like that of the mulberry silkworm, as the thread is not continuous, and it therefore has to be spun like ordinary silk waste. Eri silk takes dyes well, and when woven into cloth far surpasses cotton in durability. For a general account of the rearing of this and other wild or semi-wild silkworms, the preparation of the cocoons for spinning or reeling and the possibilities of introducing the insects into British Colonies, see this BULLETIN (1915, **13**, 87).

In June, 1917, a sample of Eri silk which was stated to have been prepared by a native by boiling the cocoons in a solution of washing soda and then teasing out the silk with the fingers was received at the Imperial Institute from the East Africa Protectorate. It was desired to ascertain whether the silk would be marketable in this form or, if not, how it should be prepared.

The sample consisted of a tangled mass of clean, soft, degummed silk, varying in colour from cream to pale brown.

The material possessed the usual appearance, lustre and strength of Eri silk. The single fibres of the silk were of normal character when viewed under the microscope; the diameter varied from 0·0003 to 0·0012 in., being mostly about 0·0008 in.

The sample was submitted for suggestions and valuation to the Silk Production Committee of the Imperial Institute, who advised that this Eri silk should not be degummed in East Africa before shipment, but that the cocoons should be exported after being turned inside out to free them from dirt, etc. A machine for reversing the cocoons, and the method of using it, are described by Lefroy and Ghosh in their monograph on Eri silk in *Memoirs of the Agricultural Department of India* (*Entomological Series*), vol. iv., p. 78, and it was suggested

that the use of this machine in East Africa should be considered. The reversed and cleaned cocoons should be packed in bales for shipment, the white and brown cocoons being packed separately.

The sample was stated to be of similar quality to consignments of Eri silk recently received from Assam, and was valued as follows in the United Kingdom (March 1918):

Degummed (in the condition of the sample)	4*s.*	per lb.
"Reversed" cocoons	3*s.* 6*d.*	,,
Ordinary pierced cocoons	3*s.*	,,

The Silk Committee suggested that it would be advantageous if a small consignment of these cocoons, "reversed," were forwarded to the Imperial Institute so that experimental trials can be made. It would then be possible to furnish a definite report on the quality and value of the silk.

MARINE ANIMAL OILS FROM THE ANTARCTIC

IN 1915 and 1916 a large number of samples of sea-leopard oil, seal oil, and penguin oil prepared in Adelie Land during the Australasian Antarctic Expedition in 1912 and 1913 were forwarded to the Imperial Institute by Sir Douglas Mawson. The results of their examination are of considerable interest and are given in the following pages. Sir Douglas Mawson considers that there is an assured future for penguin, seal and whale industries in Antarctic regions, but that any plans for development will require careful consideration before action is taken. He is of opinion that to start such industries on proper lines will require several years of preliminary work. It will also be necessary to introduce some form of protection for the animals. It is evident, therefore, that no immediate action will be possible, but that the matter may be of some commercial importance in the future.

The oils received were as follows:

Sea-Leopard Oil.—Five samples of this oil were received.

AB. "*Crude Sea-Leopard Oil,*" stated to have been extracted from the blubber by digestion in boiling water.

This was a cloudy liquid oil, with a slight fishy odour.

The cloudiness was due to the presence of a small amount of dirt. After hot filtration, the oil was of pale straw tint and remained clear and bright on cooling.

D. "*Sea-Leopard Oil.*"—This oil was similar to the crude oil described above, but was less cloudy. After filtration, the oil was clear and of pale straw colour.

E. "*Sea-Leopard Oil.*"—This consisted of a clear yellow liquid oil, with a fishy odour. A small amount of dirt was present. After filtration the oil was clear and of pale straw tint. The oil was similar to sample AB and paler than sample D.

I. "*Best Quality* (*thinnest*) *Sea-Leopard Oil, bottled June* 1913. *Adelie Land.*"—This was a clear, pale straw-coloured oil, with a fishy odour. The oil was rather lighter in colour than any of the three preceding samples.

K. "*Good Quality* (*not the thinnest*) *Sea-Leopard Oil, bottled June* 1913. *Adelie Land.*"—This sample consisted of a clear, pale straw-coloured liquid oil, with a fishy odour, and very similar to samples E and I described above.

Seal Oil.—Seven samples of seal oil were received:

F. "*Weddell Seal Oil extracted by Heat.*"—This sample was contained in six bottles—seven bottles were received, but one had been broken in transit.

F 1. The oil in five of the bottles was a golden-yellow, clear, slightly fluorescent liquid oil, with a fishy odour.

F 2. The oil in the sixth bottle differed in appearance from that in the first five bottles (F 1), and was therefore examined separately. It was cloudy owing to the presence of stearin and a small amount of dirt.

H. "*Weddell Seal Oil, 2nds extracted by Heat.*"—This sample was contained in two bottles. The oil in the two bottles differed in appearance, and the contents of each bottle were therefore examined separately.

H 1. This was a golden-yellow, slightly fluorescent liquid oil with a fishy odour.

H 2. This sample was similar to H 1, but was evidently not identical in quality, as it contained a fair amount of pale brown stearin together with some dirt and water.

J. "*Weddell Seal Oil.*"—The contents of the bottle

had apparently leaked during transit and the sample received weighed only 1½ oz. It was a bright-yellow, clear liquid oil, with a fishy odour.

L. "*Thinnest Seal Oil, June* 1912, *Adelie Land.*"—This was a bright-yellow, clear liquid oil, with a fairly strong fishy odour. It was presumed to represent Weddell seal oil, though labelled only "Seal oil."

G. (*Label illegible.*)—This was a golden-yellow fluorescent oil, similar to sample F 1 of "Weddell Seal oil extracted by Heat." It was not examined.

Penguin Oil (*Sample C*).—This was a brownish-yellow cloudy viscous oil, containing a considerable amount of stearin and having a fishy odour.

The samples were examined at the Imperial Institute, with the results given in the table on the opposite page.

All the oils appeared to have been carefully prepared, as they were fairly light in colour and free from any appreciable quantities of dirt or water. The acid values are satisfactorily low and show that the oils have remained in good condition.

The following table shows the maximum, minimum and average figures given by the various samples of sea-leopard and Weddell seal oil:

Oils.		Specific gravity at $\frac{15^\circ C.}{15^\circ C.}$	Saponification value.	Iodine value. *Per cent.*	Solidifying point of fatty acids.
Sea-leopard oil	Maximum	0·925	195·1	127·5	11·9° C.
	Minimum	0·924	193·7	119·7	3° C. to 4° C.
	Mean	0·9245	194·4	123·8	—
Weddell seal oil	Maximum	0·931	201·5	147·8	19·0° C.
	Minimum	0·924	192·0	122·1	16° C. to 17° C.
	Mean	0·9275	195·1	134·6	—

From the above figures it is evident that sea-leopard oil and Weddell seal oil are very similar in character. There are, in fact, greater variations between the constants of the different samples of sea-leopard oil or of Weddell seal oil than between the mean values for the two kinds of oil. The iodine value of the Weddell seal oil appears on the whole to be rather higher than that of the sea-leopard oil; and the solidifying point of the fatty acids of the Weddell seal oil is distinctly higher than that of the sea-leopard oil, indicating the presence of a larger amount of "stearin" in the former oil.

Sample.	Specific gravity at 15° C./15° C.	Acid value.	Saponification value.	Iodine value.	Insoluble fatty acids.	Unsaponifiable matter.	Volatile Acids.		Solidifying point of fatty acids.
							Soluble.	Insoluble.	
				Per cent.	*Per cent.*	*Per cent.*			
Sea-Leopard Oil AB "crude" [1]	0·924	0·8	194·8	119·7	94·6	0·5	0·65	1·05	11·9° C.
,, ,, ,, D	0·925	1·0	194·6	123·7	—	—	—	—	—
,, ,, ,, E	0·924	1·1	195·1	121·0	—	—	—	—	—
,, ,, ,, I, "Best quality (thinnest)"	0·925	0·5	193·7	127·5	—	—	—	—	3° to 4° C.
,, ,, ,, K, "Good quality (not the thinnest)"	0·924	0·3	195·0	127·1	—	—	—	—	—
Weddell Seal Oil F 1	0·926	0·8	195·1	133·1	94·3	0·9	0·60	0·90	19·0° C.
,, ,, ,, F 2	0·924	1·1	193·1	131·0	—	—	—	—	18·5° C.
,, ,, ,, H 1 "2nds"	0·927	1·1	192·0	144·3	—	—	—	—	16° to 17° C.
,, ,, ,, H 2, "2nds"	0·928	4·2	194·4	129·5	—	—	—	—	—
,, ,, ,, J	0·929	2·7	201·5	122·1	—	—	—	—	—
,, ,, ,, L, "thinnest"	0·931	1·6	194·6	147·8	—	—	—	—	—
Penguin oil C [2]	0·932	2·3	197·5	126·9	94·7	0·5	0·65	1·0	31·4° C.

[1] *Average sample from four tins after mixing contents.*
[2] *Average sample from two bottles after mixing contents.*

With reference to the sea-leopard oils a comparison of the figures for the "crude" oils and the "thin" oils from which stearin had been removed shows that the "best quality, thinnest" oil (sample I) had a rather higher iodine value than samples AB, D and E of this oil; the solidifying point of the fatty acids is also distinctly lower. The other sample of "thin" sea-leopard oil (sample K) was too small for detailed examination, but it was evidently very similar to sample I.

In the case of the seal oils, sample L, described as "thinnest seal oil" and presumably derived from the Weddell seal, was too small for detailed examination, but the high iodine value indicates that the sample differs from the "entire" oil in having had stearin removed.

Sample H 1 of Weddell seal oil, labelled "2nds extracted by heat," appeared to be a "thin" oil, and it obviously differed from the other oil (sample H 2) bearing the same label.

The sample F 2 of "Weddell seal oil extracted by heat" differed from the bulk of the oil bearing the same label (sample F 1), in that it contained stearin, but it did not show any appreciable variation from F 1 in composition. The presence of stearin in sample F 2 may be due to the bulk of the oil not having been thoroughly mixed before transference to the bottles, F 2 representing the lower layer of the original sample, which would, of course, contain any dirt and stearin present.

The reason for the comparatively high saponification value of sample J of Weddell seal oil is not clear, but it may be due to contamination with some other oil.

The penguin oil is quite different in appearance and character from either the sea-leopard oils or the Weddell seal oils, but its chemical constants only differ materially in the case of (1) the saponification value, which is a little higher, and (2) the solidifying point of the fatty acids, which is much higher in the penguin oil than in the other oils under report, probably owing to the presence of comparatively large quantities of "stearin."

Most of the oils were submitted for valuation to a large firm of importers of similar oils, who reported that a market could easily be found for oils represented

by the samples. They stated that the commercial value of the sea-leopard oils might be based upon that of Newfoundland seal oil, and that the Weddell seal oils should meet the same commercial requirements as No. 1 Whale Oil, whilst the penguin oil might be offered in competition with No. 2 Crude Whale Oil. The firm stated that all the oils submitted to them were suitable for soap-making and yielded a considerable quantity of glycerine, whilst they could also be utilised for the production of fatty acids of considerable value. They further mentioned that, when filtered, the oils would be suitable for a variety of purposes, such as burning in colliery lamps, the tempering of steel, leather dressing, etc., whilst the stearin obtained on filtering would be suitable for soap-making or for "splitting," *i.e.* for the production of glycerine and fatty acids.

The recent and pre-war prices of whale and seal oils are shown in the following table:

	Pre-war price. *Per ton.*	Recent price. *Per ton.* (Dec. 1917.)
No. 1 Whale oil	£23–£24	£55–£56
No. 2 Whale oil	£21–£22	£53–£54
Newfoundland seal oil—water white .	£50	£100

The samples of sea-leopard and seal oils are of good quality and mostly of good colour, and consignments of similar character would evidently be readily saleable for purposes to which commercial seal and whale oils are applied. It is probable that these oils would also be suitable for conversion into solid fats by "hydrogenation," and the products might then prove to be of value for edible purposes.

The penguin oil would be of lower value than commercial seal oil, owing to its darker colour and thicker consistence.

The "thin" oils obtained after separating the stearin from the crude products would be more valuable than the "entire" oils. The separated "stearin" should be saleable as "fish stearin" or "fish tallow" for soap-making and leather currying.

CINNAMON BARK FROM THE GOLD COAST

A SAMPLE of cinnamon bark from the Gold Coast, stated to have been grown and prepared at the Tarquah Agricultural Station, was forwarded to the Imperial Institute by the Director of Agriculture in October 1917.

It consisted of pieces of rolled bark, pale brown in colour, and about 12 in. in length and 1 in. in width. The larger sticks consisted of two pieces of bark rolled together.

The aroma of the material was not so delicate as that of Ceylon cinnamon bark.

A small scale distillation trial was made with the bark at the Imperial Institute in order to determine the yield of volatile oil, and the following results were obtained :

	Per cent.
"Heavy" oil which separated from the aqueous distillate	1·18
"Light" oil extracted with ether from the aqueous distillate	0·30
	1·48

Ceylon cinnamon bark furnishes from 0·5 to 1·0 per cent. of oil, so that the yield from the present sample of bark from the Gold Coast is extremely good. The "heavy" oil possessed a very fragrant odour.

The "heavy" oil was submitted to chemical examination with the following results, which are shown in comparison with the constants recorded by Parry (*Chemistry of Essential Oils*) for English distilled cinnamon bark oil and with the standards required by the British Pharmacopœia (1914) :

	Present sample of "heavy" oil.	Figures recorded by Parry for English distilled oil.	Requirements of the British Pharmacopœia.
Specific gravity at $\frac{15^\circ\ C.}{15^\circ\ C.}$	1·042	0·995 to 1·040	1·000 to 1·030
Refractive index	1·603	1·570 to 1·585	1·565 to 1·580
Aldehydes *per cent.*	86 (approx.)	58 to 70	55 to 65
Solubility in 70 per cent. alcohol	Soluble in 2·4 vols.	Soluble in 3 vols.	Soluble in 3 to 4 vols

The results of the examination of the "heavy" oil obtained from this sample of cinnamon bark from the Gold Coast indicate that the entire oil (including both the "heavy" and "light" fractions) which would be

obtained on distilling on a large scale should contain at least 68 per cent. of aldehydes.

The bark was submitted for valuation to a firm of brokers in London, who stated that the sample consisted of rather stout quills of fair quality but of poor flavour, and valued it at about 1s. per lb. ex wharf London (January 1918).

Samples of the bark and of the " heavy " oil prepared at the Imperial Institute were also submitted to a firm of essential oil distillers, who evinced much interest in the products and expressed a desire to obtain a few cwts. of the bark for trial distillation on a commercial scale. The firm stated that the oil was exceedingly nice and valued it at 5s. per oz. in London, or possibly a little more, as the market for cinnamon bark oil is very good at the present time (February 1918).

The results of this preliminary investigation indicate that cinnamon bark from the Gold Coast gives a high yield of oil of good quality, and as it seemed desirable to have a distillation carried out on a larger scale in order to obtain definite figures of the yield of oil under commercial conditions, it was suggested to the Gold Coast authorities that it would be advantageous if a consignment of a few cwts. of the bark could be forwarded to the Imperial Institute for trial by the manufacturers referred to above.

BALSAM OF COPAIBA FROM COLOMBIA

BALSAM of copaiba is a semi-liquid oleo-resin obtained from various South American leguminous trees belonging to the genus *Copaifera*, the principal species being *C. Lansdorffii*, Desf., of Brazil. The balsam is obtained by making incisions in the trunk; it is at first thin and colourless, but soon becomes thicker in consistency and yellow.

A sample of balsam obtained from *C. officinalis*, Linn., in Colombia was received for examination at the Imperial Institute in September 1917.

It consisted of a clear, rather viscous, brownish-yellow liquid, which possessed the characteristic odour

of balsam of copaiba and a persistent acrid and slightly bitter taste.

The balsam was found to have the following constants, which are quoted in comparison with the range of figures recorded by various observers for varieties of South American copaiba balsam:

		Present sample.	Range of figures recorded for South American copaiba balsam.
Specific gravity at $\frac{15° C.}{15° C.}$	. .	0·961	0·915 to 1·009
Acid value	. . .	79·8	25 to 98
Ester value	. . .	11·7	0 to 33
Yield of essential oil	*per cent.*	45·5	27 to 85

The essential oil from the present sample of the balsam had a specific gravity of 0·899 and an optical rotation of $-21·65°$, these figures being well within the limits recorded for the oil from South American copaiba balsam.

The balsam and the volatile oil were further examined in order to determine whether they satisfied the requirements of the British Pharmacopœia of 1914, and the following results were obtained:

Requirements of the British Pharmacopœia.	Results of tests on the present sample from Colombia.
Balsam :	
(1) Entirely soluble in absolute alcohol.	(1) Entirely soluble.
(2) Soluble in 4 times its volume of petroleum spirit, the solution yielding only a slight filmy deposit on standing.	(2) Soluble except for a small precipitate which separated on standing.
(3) Forms a transparent solution with ½ of its own volume of "solution of ammonia."	(3) Entirely soluble, forming a transparent solution.
(4) Gurjun balsam test.	(4) Negative result.
Volatile Oil :	
(1) Refractive index at 25° C., 1·494 to 1·500.	(1) Refractive index was 1·497.
(2) Distils between 250° C. and 270° C.	(2) Distilled between 255° C. and 270° C.
(3) Gurjun balsam test.	(3) Negative result.
(4) Optical rotation of the first 10 per cent. of oil when distilled *in vacuo* must be lower than that of the original oil.	(4) Not determined, owing to the insufficient quantity of oil available.

From the above results it will be seen that the present sample of copaiba balsam from Colombia satisfies the requirements of the British Pharmacopœia and would be suitable for medicinal use.

A sample of the balsam was forwarded to a firm of

brokers, who stated that, owing to the scarcity of this product at the present time, its value should be about 4*s.* 6*d.* per lb., ex warehouse London.

TOBACCO FROM CEYLON

In a previous number of this Bulletin (1912, **10**, 187), an article was published on the tobacco industry of Ceylon, including an account of the results of examination at the Imperial Institute of samples of native-grown tobacco and of cigar tobacco produced in the course of experiments carried out by the Ceylon Agricultural Society at Maha Iluppallama. In 1914 a tobacco expert was appointed to the Department of Agriculture, and experiments have since been carried out at an Experiment Station at Jaffna.

In October 1915 twenty-six samples of tobacco from the first crop grown at Jaffna were received at the Imperial Institute for examination and commercial valuation, and two years later five further samples grown at the Experiment Station were received. The results of examination of these samples are given in the present article. It will be seen that although the report on the first set of samples was not particularly favourable, the later samples of White Burley tobacco were of much better quality and quite suitable for the English market. Altogether 10 acres have been planted with White Burley tobacco at Jaffna in the 1918 season, and at a meeting of the Committee of Agricultural Experiments, Ceylon, held on May 9, 1918, it was announced that a firm of merchants had offered to purchase the 3,000 lb. of tobacco available from the 1918 crop at 1*s.* 9*d.* to 1*s.* 10*d.* per lb., delivered in London.

Samples received in 1915

No. 1. "*White Burley Flyings.*"—This sample consisted of light brown, thin leaves from 18 to 19 in. long and from 8 to 12 in. wide.

No. 2. "*White Burley Trash.*"—These leaves were about 19 in. long and from 9 to 11 in. wide. They were of a light brown colour, and rather badly torn.

No. 3. "*White Burley Lugs.*"—These leaves were

fairly uniform in size, being about 22 in. long and 10½ in. wide. They were of a light brown colour and were somewhat spotted and slightly torn.

No. 4. "*White Burley Bright Leaf.*"—These leaves were medium brown in colour and were of fairly uniform size, 24 in. long by 12 in. wide. A few of the leaves were badly spotted and torn.

No. 5. "*White Burley Red Leaf.*"—These leaves were of a dull brown colour, but darker on the upper surfaces. They were about 21 in. long by 10½ in. wide.

No. 6. "*Sumatra Wrapper Leaf. American Seed.*"—These leaves were of uniform size, about 20 in. long and 12 in. wide, and varied in colour from greenish-brown to dull brown. The leaves showed a few spots and were a good deal torn. Some of the leaves were fairly thin, but others were thicker than is desirable in good wrapper leaf.

No. 7. "*Connecticut Seed Leaf Wrapper.*"—The length of these leaves varied from 20 to 23 in., and their width from 9 to 10 in. They varied in colour, but were mostly dark brown and slightly greenish in places. Most of the leaves were discoloured and many slightly torn. The veins were prominent.

No. 8. "*Connecticut Havana Wrapper. American Seed.*"—These leaves were about 20 in. long and 9 to 12 in. wide; they varied in colour, but were chiefly dark brown. The midribs were large and coarse.

No. 9. "*Dumbara Wrapper Leaf. Native Seed.*"—The leaves were fairly uniform in size, being 20 to 23 in. long and 9 to 11 in. wide. Their colour varied from dull to reddish-brown with some green patches. On the whole the leaves were coarse and rough.

No. 10. "*Samsoun.*"—The leaves measured from 8 to 10 in. in length, and from 4 to 5½ in. in width. They were of irregular colour, varying from light yellowish-brown with green patches to orange-brown. The leaves were a good deal spotted and torn.

No. 11. "*Dark Export: Germine Pryor.*"—These leaves were about 28 in. long by 15 in. wide and were of a mottled dark brown colour.

No. 12. "*Dark Export: Blue Pryor.*"—The leaves were uniform in size, being 24 in. long and from 12 to 14 in.

wide. They varied in colour, but were mostly dark reddish-brown.

No. 13. "*Dark Export: Tinnevelle.*"—These leaves were uniformly about 25 in. long by 13 in. wide and were dark greenish-brown in colour.

No. 14. "*Dark Export: Improved Yellow Mammoth.*"—The leaves varied in colour, but were mostly dark brown; they were about 22 in. long and from 12 to 14 in. wide.

No. 15. "*Dark Export: Clardy.*"—The leaves were about 24 in. long and 15 in. wide, and were mostly dark greenish-brown in colour.

No. 16. "*Dark Export: Hester.*"—The leaves were about 22 in. long by 12 to 14 in. wide, mostly with a dull dark brown colour.

No. 17. "*Dark Export: Yellow Pryor.*"—These leaves varied in colour from dull to dark reddish-brown and were 22 in. long by 11 to 14 in. wide.

No. 18. "*Dark Export: McAdoo.*"—These leaves were uniformly dark brown in colour, and measured 23 in. long by 12 in. wide.

No. 19. "*Dark Export: Madole.*"—The leaves varied in colour, but were mostly dark brown and measured about 22 in. long by 10 to 11½ in. wide.

No. 20. "*Dark Export: Jaffna.*"—These leaves varied in colour from reddish-brown to dark brown, and were about 21 in. long by 9½ to 11 in. wide.

No. 21. "*Dark Export, partially flue-cured.*"—The leaves were about 19 in. long by 11 in. wide and varied in colour from brownish-yellow to dark brownish-orange.

No. 22. "*Zimmers Spanish Cigar-filler. American Seed.*"—The colour of these leaves varied from greenish- or yellowish-brown to reddish-brown. They were uniformly about 18 in. long by 7 to 10 in. wide.

No. 23. "*Texas Cuban Cigar-filler. American Seed.*"—These leaves varied in colour from medium brown to reddish-brown, and were about 17 in. long and from 10 to 12 in. wide.

No. 24. "*Indian Cigar-filler. Indian Seed.*"—The leaves varied in colour from orange-brown to dark reddish-brown and were about 21 in. long by 7 to 11 in. wide.

No. 25. "*Dumbara Cigar-filler. Native Seed.*"—

These leaves were from *15 to 17 in. long by about 8 in.* wide, and were of irregular colour, varying from dull to dark brown, some having a reddish tint.

No. 26. "Jaffna Cigar-filler. Native Seed."—These leaves varied in colour from a pale brown to medium brown and were about 17 in. long by 7 to 10 in. wide.

Of the twenty-six samples submitted, nine were selected for chemical examination, and the results of this work are summarised in the table on the opposite page.

The twenty-six samples of tobacco were submitted to two firms of manufacturers for valuation. The first firm reported that none of the samples are really suitable for the English market. They added that if the types marked as cigar-wrappers and fillers could be used at all in this country, they could only be employed as common cutting tobaccos. They stated that the flavour of all the tobaccos when smoked was pungent and unpleasant. The firm quoted the following opinions and valuations regarding the samples, pointing out, however, that it might prove impossible to sell the tobaccos even at these rates.

		Value per lb.
No. 1.	Too thin-bodied	3*d.*
,, 2.	Deficient in quality when smoked	3*d.*
,, 3	Fair colour; not much body	4*d.*
,, 4.	Fair tobacco in colour and length	4*d.*
,, 5.	Fairly useful in colour and length	4½*d.*
,, 6.	Poor	2½*d.*
,, 7.	Very rough and coarse	2½*d.*
,, 8.	Rather rough	3*d.*
,, 9.	Unsuitable for cigars	4*d.*
,, 10.	No aroma, resembling that of Samsoun tobacco; too short for other use	nil
,, 11.	Long but very rough and coarse	3*d.*
,, 12.	Very rough and coarse	2½*d*
,, 13.	Very rough and coarse	3*d.*
,, 14.	Clean, but rough and coarse	3*d.*
,, 15.	Heavy-bodied, rough and coarse	3*d.*
,, 16.	Poor flavour, rough and coarse	2½*d.*
,, 17.	Rough and coarse	2½*d.*
,, 18.	Rough and coarse	3*d.*
,, 19.	Very coarse	2½*d.*
,, 20.	Narrow, rough leaf	2½*d.*
,, 21.	Poor and brittle	1½*d.*
,, 22.	Green, unripe and poor	2*d.*
,, 23.	Short and rough	2½*d.*
,, 24.	Very narrow sandy leaf	2½*d.*
,, 25.	Unsuitable for cigars	2*d.*
,, 26.	Unsuitable for cigars	2*d.*

ANALYSES OF CEYLON TOBACCOS

	Burley.	Sumatra.	Pryor.	Tinnevelle.	Zimmers, Spanish.	Texas, Cuban.	Indian.	Dumbara.	Jaffna.
	Sample No. 3.	Sample No. 6.	Sample No. 11.	Sample No. 13.	Sample No. 22.	Sample No. 23.	Sample No. 24.	Sample No. 25.	Sample No. 26.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Moisture[1]	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0	14·0
Nicotine	2·1	2·7	3·8	4·0	2·9	2·2	2·5	1·7	1·8
Nitrogen	1·9	2·5	3·1	3·2	2·6	2·2	2·2	2·7	1·9
Ash	24·6	18·3	17·3	15·5	18·9	19·4	21·2	17·2	21·7
The ash contained:									
Lime (CaO)	33·4	33·6	28·8	27·1	34·8	30·6	27·7	34·3	30·2
Magnesia (MgO)	5·5	8·1	6·1	5·1	6·4	6·4	3·3	7·6	6·6
Potash (K_2O)	16·3	16·1	22·7	18·5	16·0	9·3	11·9	10·6	6·7
Soda (Na_2O)	2·8	2·8	2·9	3·2	2·7	2·1	3·3	5·0	1·9
Sulphates, expressed as sulphuric acid (SO_3)	2·7	3·0	3·2	3·1	2·8	1·7	2·1	3·9	2·1
Chlorides, expressed as chlorine (Cl)	15·0	13·4	9·5	9·2	14·7	12·1	9·2	10·4	7·6
Carbonates, expressed as carbon dioxide (CO_2)	11·3	10·7	18·1	12·6	12·8	6·6	8·1	11·3	8·6

[1] *All the samples were "conditioned" at the Imperial Institute before examination and the quantities of moisture recorded are those found in he "conditioned" tobaccos.*

The second firm stated that the tobaccos represented by these samples are not suitable for the British market, but suggested that they might find a market in small quantities for mixing at 4*d.* to 6*d.* per lb. They added that the White Burleys, samples Nos. 1 to 5, might, with careful cultivation, be made suitable for the British market.

The results of the analysis of the nine samples of tobacco which were examined in detail show great variation in the composition of the tobacco, although the samples were all grown in the same locality and were apparently all subjected to the same treatment, viz. air-curing. The amount of nicotine is not excessive, although in Nos. 11 and 13 it is rather high, especially when the high nitrogen in these two samples is also taken into account. These, however, are both described as "dark export chewing tobaccos," and in these types high nitrogen and nicotine are less objectionable features than in smoking tobaccos.

The amount of ash present in the tobaccos shows considerable variation, but the most noteworthy point, as regards the composition of the ash, is the variation in the amount of potash, which ranges from 6·7 in sample No. 26 to 22·7 in sample No. 11. The burning quality of tobacco is largely determined by the amount of potash, and in selecting varieties for further trial in Ceylon some attention should be given to this point.

The quantities of sulphates and chlorides in tobacco are also important, as these adversely affect the burning quality. The chlorides are present in excessive amount in all these tobaccos, indicating that the soil at the Jaffna Trial Ground contains considerable quantities of chlorides. Attention has been directed to this point in previous reports on Ceylon tobacco (see "The Tobacco Industry of Ceylon," this BULLETIN, 1912, **10**, 187). Most of the Ceylon tobaccos examined at the Imperial Institute have proved to contain excessive quantities of chlorides, and this is a serious difficulty in the way of producing smoking tobacco of first-class quality, particularly cigar tobacco. There is, however, one interesting exception to this, viz. the sample grown at Talwatte from Dumbara seed,

and examined at the Imperial Institute previously. The percentage of chlorides in this sample was 0·61 as compared with amounts ranging between 7·6 and 15·0 per cent. contained by the nine samples which are dealt with above.

A number of the present tobaccos were cut for the Imperial Institute by a manufacturer and their burning quality tested in the form of cigarettes. When fine cut they burned fairly well, but in no case could the burning be described as good. Still it was not bad enough to prevent the use of these tobaccos on that ground alone, since for cutting purposes it would be possible to blend them with tobaccos such as those of Nyasaland, which show particularly good burning quality. In the case of the cigar tobaccos, however, poor burning quality is a more serious defect.

It would be unsafe from the data at present available to draw final conclusions from the analyses of these tobaccos, but the following suggestions may be tentatively put forward for consideration in arranging future trials:

(1) Judging from the general tendency to coarseness shown by all these tobaccos and the rather high nitrogen and nicotine figures shown by some, the soil in this trial ground is too rich in organic matter for tobacco cultivation; this condition has probably been produced by heavy manuring with organic manures. The soil is probably rather poor in the mineral constituents necessary for plants, especially potash, though it seems to be fairly rich in lime and magnesia.

(2) The use of manures containing chlorides and sulphates should be avoided.

(3) In any further manuring of the ground manures rich in potash, such as wood ashes, should be applied.

In considering these suggestions it should be pointed out that no information was supplied with the samples as to the composition of the soil, the manurial treatment, if any, adopted, or as to the previous cultural history of the trial ground. All these factors are of great importance, and the foregoing suggestions may need correction in the light of local knowledge on these points.

It will be observed that the opinions expressed by

the two firms of manufacturers to whom these samples were submitted were not favourable to the tobaccos. The samples were small, and consequently it was not possible within a reasonable time to get a wider expression of opinion from manufacturers; but the two firms selected make a great variety of manufactured tobaccos and have both shown commendable enterprise in utilising British grown tobacco from new sources in recent years; so that it may safely be assumed that they do not take unduly conservative views of the requirements of the British market.

It must, however, be borne in mind that tobacco manufacturers in the United Kingdom have for the most part established well-known brands of manufactured tobaccos, the characteristics of which they must maintain. To enter the British tobacco market it is therefore necessary that new producers should endeavour to imitate as far as possible the raw tobaccos which come on this market. The principal demand in this country for the manufacture of "Virginian" cigarette and pipe tobaccos is for bright and semi-bright tobacco, and none of the tobaccos now reported on belong to either of these categories. There is undoubtedly a large market for so-called nondescript and dark tobaccos for cutting, but this can always be met by inferior tobacco, of which a certain amount must always be available in every tobacco-growing country.

Owing to the limited capacity of the fire-curing barn at Jaffna, most of the samples had to be air-cured, and this no doubt accounts to some extent for the absence of bright and semi-bright types from the present series of samples, and this defect may be remedied in the next season. The possibility should, however, not be lost sight of that the prevalence of dark coarse tobaccos in this series of samples may be due to unsuitability of soil, and this point should be settled as soon as possible by (1) a careful investigation of the improvement possible by means of flue-curing at Jaffna next season, and (2) trials in other parts of the island.

Special mention may perhaps be made of sample No. 10, which is stated to be grown from Turkish seed.

It is almost entirely devoid of the characteristic aroma of Turkish tobacco. Its defects may be due to the use of deteriorated seed.

SAMPLES RECEIVED IN 1917

(1) "*Specially selected Trash Grade, White Burley.*"—This consisted of five hands, composed of light yellowish- or orange-brown leaves 17½ to 24 in. long and from 8 to 11 in. wide. The leaves were fairly thin, but of fair strength; they all showed some stains, and many of them were badly marked.

(2) "*Specially selected Lug Grade, White Burley.*"—This sample consisted of four hands, composed of light orange-brown leaves 21 to 27 in. long and 8½ to 14 in. wide. The leaves had fair body and strength, but were slightly thinner than those of sample No. 3 (Leaf Grade). All the leaves showed stains, and some of them were badly marked.

(3) "*Specially selected Leaf Grade, White Burley.*"—This consisted of four hands composed of leaves from 21½ to 29 in. long and 8½ to 14 in. wide and of light to medium reddish-brown colour. The leaves had good substance and fair strength, and were of rather finer texture than the leaves of the bulk sample (No. 4). Most of them showed stains.

(4) "*White Burley (Bulk Sample).*"—This sample consisted of a number of unlabelled hands, composed of leaves from 22 to 30 in. long and 9 to 14 in. wide, mostly of a medium reddish-brown colour; some of the leaves were similar to those of sample No 2 (Lug Grade). The leaves were of good substance and fair strength; most of them showed some stains.

(5) "*Turkish Cigarette, Imported Seed.*"—This consisted of a bundle of leaves varying from 6½ to 10½ in. in length and from 2½ to 5¼ in. in width. The colour was mainly a medium warm brown, with many dark brown discolorations principally along the midrib, whilst several leaves were of yellow or orange tint and a few greenish-yellow. The leaves were of fine texture and fairly strong, but many had been badly attacked by tobacco grubs, and many also showed stains.

The "bulk" sample (No. 4) of White Burley leaf was submitted to chemical examination with the following results, compared with those obtained for a previous sample of "White Burley Lugs" from Ceylon (see p. 153).

	Present sample of "White Burley" grown at Jaffna (1917). *Per cent.*	Previous sample of "White Burley Lugs" grown at Jaffna (1914–15). *Per cent.*
Moisture	14·0	14·0
Nicotine	4·6	2·1
Nitrogen	3·4	1·9
Ash	19·0	24·6

Calculated to correspond to 14 per cent. of moisture.

The ash was analysed with the following results:

		Present sample. *Per cent.*	Previous sample. *Per cent.*
Lime	CaO	34·7	33·4
Magnesia	MgO	7·0	5·5
Potash	K_2O	14·4	16·3
Soda	Na_2O	2·5	2·8
Sulphates, expressed as sulphuric acid	SO_3	3·5	2·7
Chlorides, expressed as chlorine	Cl	14·2	15·0
Carbonates, expressed as carbon dioxide	CO_2	15·8	11·3

The four samples of White Burley showed very fair burning properties for this type of tobacco, but there was an almost entire absence of pleasant flavour. A mixture of the Burley tobacco with three times its weight of Nyasaland "Gold Leaf" was found to burn satisfactorily.

The sample of Turkish leaf, although of poor colour, had a fairly good flavour and "Turkish" aroma, but it did not burn well and the smoke was somewhat pungent.

Owing to the inferior appearance of the Turkish tobacco it was not submitted for valuation, but the following reports on the four samples of White Burley tobacco were obtained from three firms of manufacturers and a firm of merchants.

(1) One firm of manufacturers stated that the colour and length of the leaves were both particularly good, although the stalk appeared to be rather heavy in proportion to the leaf, which would cause a heavy loss in stripping. They considered that the tobaccos would be useful for blending, and stated that at the present time there would be a good market for them, as this description of leaf is very scarce and much wanted. The value in

London of tobacco similar to these samples at the time they were examined (January 1918) was from 1*s.* to 1*s.* 4*d.* per lb., according to colour.

(2) Another firm of manufacturers reported that the colour of the tobacco was very good and the "body" a good average for Burley tobacco. They considered that the current American prices for tobacco represented by the samples would be as follows :

Trash Grade	7*d.* per lb.
Lug Grade	9*d.* ,,
Leaf Grade	10*d.* ,,
Bulk sample	1*s.* ,,

(3) The third firm of manufacturers were of opinion that the tobaccos would not be very suitable for use in the United Kingdom owing to the woody stalks and the lack of flavour. The firm could not assign a value to the samples under present conditions, but they stated that in normal times the tobaccos might be worth 3*d.* or 4*d.* per lb. for their purposes.

(4) The merchants reported that the tobaccos were well grown and handled, and quite suitable for the United Kingdom market. They valued them as follows :

Trash Grade	7*d.* per lb.
Lug Grade	9*d.* ,,
Leaf Grade	11*d.* ,,
Bulk sample	1*s.* ,,

The chemical examination of the tobaccos shows that they contain a high percentage of chlorides and are deficient in potash, which would adversely affect the burning properties. The amounts of nicotine and nitrogen in the present samples are also unduly high. The results indicate that the samples were grown in soil containing sufficient nitrogenous manure and an excess of chlorides, but deficient in potash. The effect of these soil conditions on the character of the tobacco produced has already been discussed on p. 154 of this report.

On the whole, however, the present samples of White Burley tobacco are of good appearance and of much better quality than those previously received from Ceylon, the leaves being larger and superior in substance and texture. The burning properties were fair.

SPECIAL ARTICLE

THE MAINTENANCE OF THE QUALITY OF EGYPTIAN COTTON

By Gerald C. Dudgeon, C.B.E., F.E.S.,
Consulting Agriculturist, Ministry of Agriculture, Egypt

Egyptian cotton holds its high position in the world's markets by reason of the combined qualities of fineness, strength and length, which its staple possesses in comparison with that of cotton from other parts of the world.

The climatic and cultural conditions found in Egypt afford the country unique advantages, as far as it is at present known, with respect to the production of the particular kinds of cotton possessing the above-mentioned valuable qualities.

Experiments have been conducted in India and Arizona in order to establish similar varieties there, but up to the present it has been found that Egyptian kinds grown in these new localities are less prolific and more susceptible to disease and rapid deterioration in quality than is the case in their country of origin.

Had this not been so, it is highly probable that the United States at least would have been able to put an Egyptian type of cotton on the market in competition with Egypt. In point of fact the efforts which have been made by the Department of Agriculture in the United States since 1900, in Arizona and California, to establish a pure type of Egyptian cotton there, have resulted in the isolation of three pure kinds of cotton, which, although bearing many of the characters of the cotton varieties of Egypt, are somewhat different from those grown there. The best of these three varieties is said to resemble Egyptian Nubari. The following figures showing the yields per acre obtained from the American-grown Egyptian cottons on carefully controlled farms unaffected by insect pests, give some idea of the cropping possibilities of these varieties :

	Area. *Acres.*	Yield per Acre. *lb.*
1912	480	388
1913	3,800	278
1914	12,000	255

Such yields, in view of the expensive labour system in operation in the United States, may not seem to Egyptian growers to promise great success for that country in competition with Egypt; but it is unlikely that the Department of Agriculture at Washington will be deterred from a continuance of its efforts in view of a temporary failure to attain an equality with Egyptian results. Moreover the final year's yield given above is over 50 lb. per acre in excess of the average for the whole of the cotton area in the United States, and in view of the greater value of the Egyptian type in comparison with American Upland, which constitutes the standard, and of which the majority of the country's crop is composed, the results may reasonably be regarded as hopeful in America.

The foregoing remarks are intended as a warning with respect to possible competition from the outside, and as introductory to the point to be made with regard to the necessity, on behalf of the cultivating as well as of the ginning class in Egypt, of combining to preserve the superior position which Egyptian cotton has hitherto maintained.

To any one who has watched the development of Egyptian cotton it is evident that the life of any variety of cotton in Egypt extends for a few years only. This life is determined by the length of time occupied in its becoming so impure that its characteristic advantages are no longer apparent. The loss of purity, which proceeds more rapidly, or is perhaps more readily conspicuous in some varieties than in others, causes a depreciation in value which has frequently rendered the position of the Egyptian cotton industry precarious. It is true that on every occasion when the danger has become imminent, the situation has been fortuitously saved by the introduction of a new variety showing improved qualities in comparison with the variety which has declined, and which it is destined to replace. These new varieties in their turn, for want of proper control, proceed to deteriorate in the same manner as soon as their cultivation becomes extensive. The reason for this deterioration of varieties is explained below, but it must be borne in mind that it is quite distinct from *degeneration of the*

Egyptian type, which is in fact non-existent, although frequently confused with varietal decline. As far as is known, in the case of every variety which has obtained commercial acknowledgment, the origin has been a single plant chosen for the different botanical characters exhibited in comparison with other plants in the field, and for the special advantages with regard to its lint and cultural features. Out of many plants selected in this way, the seeds of a few have been found to produce plants altogether true to the parent type, and these only have been permitted to become established. There appears to be the strongest evidence that most, if not all, of the commercially known varieties have such an origin, and that they are not splitting forms which it is impossible to retain long in a uniform condition. The phenomenon of discontinuity in variation which the behaviour of certain commercially established Egyptian varieties has exemplified, was noted by Bateson towards the end of the last century, and it was then suggested by him that such may have played an important part in the production of species. In 1901–3, Hugo de Vries, a Dutch botanist, emphasised Bateson's point of view, and gave the name of "mutations" to such variations. Mutation in plants may be defined then as a type of variation which manifests itself as a sudden appearance of a distinctly different individual, whose characters are identically reproduced in its descendants originating from self-pollination or pollination with individuals of the same parentage. Mutants are not spontaneous or chance forms, but are developed in accordance with some natural law which is as yet undetermined. It has been suggested that mutants result from the mating of two forms, each of which is of an extremely complex constitution; this is a common condition with regard to Egyptian cotton. The fusion of these two forms results in the suppression of some of the characters and the emphasis of others; these differences are then constantly inherited as long as the strain is inbred. Mr. Balls, in his work entitled *The Cotton Plant in Egypt*, 1912, p. 97, dismisses the theory of the origin of our varieties from mutants in the following manner: ". . . mutations in

Gossypium ought not to be mentioned until we know much more about natural crossing and heredity than we are likely to acquire for several years to come." Again, in a later work entitled *The Development of Raw Cotton*, 1915, on page 14, the same author remarks: "The proof of its occurrence demands most careful experimentation, and, as we mentioned formerly, it will be years before such proof can be obtained clearly in the particular case of the cotton plant, although it may well be still taking place." Mr. Balls, when in Egypt, paid particular attention to the establishment of pure strains of cotton according to the Mendelian principle of plant-breeding, but it has been found by experience that it is more satisfactory from the point of view of the cultivator, as well as of the spinner, to concentrate attention upon the retention of purity of the existing appreciated varieties, than to evolve new varieties which may not be suitable when ready. The purification of the existing varieties has been advocated by the author ever since he formed the Agricultural Department in Egypt, and, at the present time, a satisfactory and apparently pure-breeding nucleus has been obtained of each of the four most important commercial strains.

Although, as already shown, Mr. Balls refused to attach immediate importance to the theory of the mutative origin of Egyptian cotton, this may have been partly due to the fact that the acceptance of the same would have been opposed to the continuance of the Mendelian plant-breeding methods, on which he placed so much reliance. Scientific cotton breeders in the United States adopted the selection system for obtaining pure varieties of Egyptian cotton there in preference to attempting to evolve new cottons by artificial pollination, and, although they have experienced great difficulties, the enunciation of the mutative capability of Egyptian cotton must be credited to them.

In reviewing the work done in Arizona, previously referred to, with regard to the efforts to establish pure types of Egyptian cotton, Mr. T. H. Kearney shows that with respect to the four distinct varieties obtained there, it may be concluded that all were of mutational origin.

In his paper entitled "Mutation in Egyptian Cotton" (*Journ. Agric. Research*, 1914, **2**, 290), he states that the first "mutant" appeared in 1908 after about eight years of discouraging results from unproductive late-maturing descendants of the Mit Afifi which was imported from Egypt. In fact two "mutants" appeared in the progeny rows in the same year, but one was discarded by reason of its late maturity and excessive development of vegetative branches. Two other varieties, which are also believed to be of mutational origin, have since been developed in the same region.

Speaking of all the commercial Egyptian cotton varieties produced in Egypt itself, the same author says: "The conclusion that these varieties originated by mutation is supported by the following facts: (1) The derivation of each from a single plant discovered in a field of very different cotton; (2) the distinctness of their botanical characters, especially in the recently developed Nubari and Sakellaridis varieties; and (3) *their tendency to remain uniform, which is, however, finally nullified by the ample opportunities afforded in Egypt for cross-pollination with other types, and for the mixing of seeds at the gins.*" The last portion of this quotation, which has been italicised, is so very important that it deserves the most particular attention. To these causes alone is due the deterioration of the Egyptian commercial varieties. They are not unstable and degenerate splitting-forms which they have frequently been supposed to be, but are, or were, "mutants" breeding pure *inter se*, and might have been retained pure had precautions been taken to prevent cross-fertilisation with impure neighbours and mixing of seed in the ginneries.

The production of a commercial variety of Egyptian cotton is usually the work of some one interested entirely in the financial aspect of the case. A single plant exhibiting specially good qualities having been discovered in a field of cotton, the seed from the plant is carefully collected and sown in the next year in an isolated position. If the plants obtained from the seed breed true to type in the subsequent generations, arrangements are made with cultivators to grow the cotton for the owner, the

latter undertaking to purchase the whole crop of seed-cotton, or the seed alone, at a favourable price. This is repeated each year until the seed is so increased in quantity that the operator cannot finance the control of it. He then sells at a high price the seed he has collected, and the planting of the variety gets out of control and at once begins to hybridise with other neighbouring cotton, and is mixed in the ginneries. The decline then starts, and proceeds with increasing rapidity.

Although purified strains of commercial kinds have been obtained by careful selection and inbreeding, and are represented by small quantities grown under Government control on specially appointed seed-farms, these in the present circumstances must become impure when they become widely diffused, owing to the fact that the Government at present has no power to dictate to the cultivator regarding the variety of cotton he shall sow on his land. When the cultivator realises the danger of not taking sufficient precautions with regard to the maintenance of purity of his seed, he may ask for the intervention of Government in the matter, and, by genuine co-operation, it should be easily possible to guarantee the life of any suitable variety of cotton for a prolonged period, if not permanently.

If the Government were asked to assume this authority, the particular areas in which each variety of cotton might be grown, as well as the group of ginneries in which the variety might be ginned, would have to be determined. All new varieties of cotton would necessarily be examined and approved by the Government before their producers were allowed to distribute them on a dangerous scale. If considered satisfactory and advantageous for commercial introduction, they would have a locality assigned for their cultivation. The control of the distribution of any particular variety of seed could be easily arranged, in view of the fact that the sole distributors of cotton-seed would be the Government and its specially appointed agents.

Let us now examine some examples in existence at the present time, where the lack of those necessary precautions, mentioned above, is militating against the

retention of commercial cottons in a satisfactorily pure condition.

In Upper Egypt, practically all the cotton grown has for many years belonged to one type, *i.e.* Ashmouni. This variety is the oldest of our commercial cottons, having been first established in Lower Egypt more than fifty years ago. During the last two decades it has been confined almost entirely to Upper Egypt, and has retained its characters well, due to the fact that it has not been associated to any large extent with other kinds of cotton.

Recently some lots have shown more impurity than hitherto, owing to the fact that perhaps 3–5 per cent. of the cotton grown in its vicinity has, in the last few years, consisted of experimental plantings of Sakellaridis and some newly isolated kinds. The inducement to plant Sakellaridis has arisen owing to the very high prices which were recently obtainable for this kind, and this in spite of the fact that smaller yields were to be expected from it in Upper Egypt than from Ashmouni. The resultant cotton did not compare in quality with that of the same variety grown in Lower Egypt, but the temporary advantage with respect to price was sufficient to encourage some planters to grow it for more than one season. The result of this introduction, as well as of that of another light-linted cotton, the seed of which is now being extensively distributed despite the fact that by many it is not considered desirable as a substitute for Ashmouni, is that a mixture of foreign seed with that of Ashmouni occurs in the ginneries, and cross-fertilisation follows in the fields.

The Ministry of Agriculture has, with great pains, succeeded in isolating a purified type of Ashmouni which, on three farms aggregating 30 feddans (1 feddan = 1·038 acres) has yielded in the last year from 6½–9½ kantars per feddan (620–906 lb. of ginned cotton per acre). The lint from this type has been pronounced by experts in Alexandria to be of excellent quality.

If, however, when the time comes for this seed to be distributed upon an extensive scale, there co-exists in the same localities where it is to be planted a distinct variety of cotton, the result must be contamination. It may be necessary to mention here that the proximity

of a finer quality of cotton, instead of, as might be imagined, improving the Ashmouni by crossing with it, could do nothing but harm, by the formation of undesirable and irregular hybrids. This, then, is the menace that awaits the laborious efforts of the Ministry to isolate a pure cotton. Of course the establishment of a purer strain may be forced on the country by the process which is at present being adopted of purifying the nucleus in each year's cultivation and eliminating the progressively contaminated strains when these get beyond control. But this is an endless work, and very easily dislocated by the accident of breaking the continuity of the original scheme. It may be contended that, after all, Ashmouni is an inferior cotton to those grown in Lower Egypt, and that any attempt therefore to establish another cotton in its place should not be regarded as a disadvantage. But it must be remembered that not only is Ashmouni particularly suited to Upper Egypt conditions, but that there is a special market for this cotton which Egypt at present holds, and that, if this were lost, spinners would have to substitute one from somewhere else, which might entail alterations in machinery. All mills cannot of course spin fine cotton, nor is fine cotton suitable for all fabrics. Once this market is lost, Egypt may never be able to recover her position of supremacy in it.

Although Ashmouni is specifically the cotton for Upper Egypt, it should in its turn be excluded from Lower Egypt, where a different kind of cotton is almost entirely grown; but, by an unfortunate circumstance, Ashmouni gives a larger crop than the ordinary Lower Egyptian kinds in certain localities in the vicinity of the desert. For this reason, the inhabitants of these localities prefer to grow it. They are encouraged in this by certain unscrupulous ginners in Lower Egypt, who eagerly buy this Ashmouni cotton for the express purpose of using it to adulterate the Nubari kinds. Not only is the cotton produced by the mixture of the two kinds extremely unsuitable from the spinner's point of view, but also, by reason of the difference in the staple, Ashmouni does not take dyes, especially black, in the same way as Nubari or other kinds: this detracts from the value of the yarn.

From the standpoint of seed-mixture, it is clear that no greater harm could be done to the standard of quality grown than that caused by ginning together two totally different kinds of cotton, in the manner adopted by the ginners who practise the fraud.

It was on account of the mixing of Ashmouni cotton from Upper Egypt with Lower Egyptian varieties becoming an extensive mal-practice in Damanhour and other places, that, at the instigation of the Alexandria General Produce Association, the Department of Agriculture, some years ago, procured the enactment of a law to compel growers of Ashmouni cotton in Upper Egypt to gin their crops to the south of a line which formed the northern boundary of the proper Ashmouni zone. At that time it was not considered likely that any cultivators in Lower Egypt would find it expedient to grow Ashmouni within the fine-cotton zone there, though it was recognised that, if this were done, there were ginners whose lack of foresight or interest with regard to the future of Egyptian cotton might lead them to encourage such an evasion of the object of the law, to enable them to carry on the adulteration without hindrance.

Ashmouni has been grown in Lower Egypt during the past year, and has been openly ginned with Nubari for a fraudulent purpose, and the resultant seed is doubtless available for sowing in the coming season with the worst possible prospects for the neighbouring cotton crops. Applications have recently been received by the Ministry of Agriculture from growers resident in parts of the Qualiubia Province for permission to buy Ashmouni seed from the Fayoum for planting in their fields.

These examples, if carefully considered by all who have the prosperity of Egyptian cotton at heart, will, it is hoped, lead the intelligent class of cultivators to call upon the Government to assume authority, in order to preserve their most remunerative industry from future injury. The matter is one which appears to demand energetic control, and it can scarcely be conceived that, if brought to public notice, it would be viewed with apathy by cultivators and ginners.

Summary

(1) Egypt has, so far as at present determined, unique advantages for the production of a special kind of cotton of high value. Attempts are being made in India and Arizona to emulate Egypt's success in this respect, and attention is drawn to the progress made in America, to be regarded as a warning of what may happen, if steps be not taken to maintain the purity of the existing Egyptian commercial varieties in this country.

(2) The period of life of an Egyptian commercial variety is not long, owing to the fact that the characteristic qualities, which constitute its value, are usually rapidly broken down by cross-fertilisation in the field and by careless mixture of seed in the ginneries.

(3) The origin of all Egyptian commercial varieties appears to have been a single plant in each case. These plants may be assumed to have been " mutant " strains, the nature of which, so long as they are each inbred, is to breed true to the parent type. The theory of the commercial varieties being ever-splitting hybrids is therefore apparently untenable. The assumption of the mutational origin of Egyptian commercial varieties is supported by what has been found to occur in experimental breeding from Egyptian seed in Arizona.

(4) The inducement for certain cultivators to select single and remarkable plants, in order to propagate new varieties, has arisen from a desire for money-making, but this advantage is only coincident with the retention of a monopoly of the seed. The impracticability of keeping this has resulted in the deterioration of the variety as soon as control was lost. The Government's attempts to fix and maintain the purity of existing types are faced with the same fate when the purified seed becomes widely distributed. The necessity of cultivators asking for the co-operation of Government in prolonging the life of pure commercial types, should be brought to public notice. The measures which the Government would have to enforce, if control were to be exercised in this matter, are stated.

(5) Examples are given of the introduction of locally

undesirable types of cotton into areas otherwise confined to the cultivation of one special kind; and of the injurious irregularity introduced into the seed for sowing by the fraudulent admixture of two totally different varieties of cotton in the operation of ginning. A statement is made of the success which has attended the efforts of the Ministry of Agriculture in the isolation of a purified type of cotton, which has yielded from 6½–9½ kantars per feddan (620–906 lb. of ginned cotton per acre) in the last year, and of which samples have been pronounced by buying-experts in Alexandria to be of excellent quality. Attention is drawn to the fact that, in the process of the dissemination of the seed descendant from the purified type, it must, under present circumstances, become impure, necessitating the incessant selection each year of a new nucleus, in order to overcome the establishment of the inevitably deteriorated descendants. This difficulty would disappear if the majority of the cultivators, as well as the ginners, could be brought to understand the position thoroughly and combine in an appeal to the Government to assist them.

GENERAL ARTICLE

INDIAN HIDES AND SKINS

HIDES and skins, raw and tanned, form one of the largest groups of exports from India. In the last year of normal trade, 1913–14, they figured in the returns of the sea-borne trade of British India to the extent of 1,900,000 cwts. valued at £10,600,000, the only groups which exceeded them in value being textile materials and manufactures, cereals, and oil seeds. The chief constituents of this trade in hides and skins are cow-hides, the exports of which, raw and tanned, were valued in 1913–14 at nearly £5,000,000, goat-skins (over £3,000,000), and buffalo-hides (over £1,500,000). Cow-hides, buffalo-hides and goat-skins together accounted in 1913–14 for over 90 per cent. of the total both by weight and by value, the balance consisting principally of sheep-skins (£800,000) and calf-skins.

Most of the hides and skins exported from India before the war found a market in countries outside the

British Empire. In the year 1913–14, for which the returns are fairly typical of pre-war conditions in this branch of trade, the exports of hides and skins, raw and tanned, from India to British countries, formed 20 per cent. of the whole by weight, and were consigned principally to the United Kingdom (19 per cent.). The exports to the United States were 28 per cent., and to all Allied countries 38 per cent., while the exports to Germany were 21 per cent., and to all enemy countries 36 per cent. By value the position of the inter-Empire trade in Indian hides and skins was a little more favourable, the proportion exported to British countries being 27 per cent. of the whole (26 per cent. to the United Kingdom). This difference between the percentage distribution of the trade by weight and by value has an important significance. It is due to the fact that the exports to British countries comprised nearly all the tanned or dressed hides (98·5 per cent.), and the great bulk of the tanned or dressed skins (80 per cent.), but only a small portion of the raw hides (5 per cent.) and raw skins (9 per cent.). The major part (59 per cent.) of the raw hides were exported to enemy countries (Germany 35 per cent., Austria-Hungary 21 per cent.), while about three-fourths (76 per cent.) of the raw skins were exported to the United States. The tanned and dressed hides and skins are classed in the Indian trade returns as leather, and though this leather is not a finished product, the tanning being only partial, especially in the case of hides, a higher value naturally attaches to the manufactured or partially manufactured article than to the raw product. In 1913–14 tanned hides and skins formed by weight (304,621 cwts.) only 16 per cent. of the total exports of hides and skins from India, but by value (£2,817,166) they formed 27 per cent. of the total. To sum up, the United Kingdom before the war controlled the trade in tanned hides and skins from India, but had little share in the trade in raw hides and skins, which was much the more important of the two, both in quantity and in total value.

The trade with enemy countries before the war was mainly in raw Indian cow-hides (kips). These were by far the largest item in the exports of hides and skins

from India. In 1913–14 the exports of raw kips amounted to nearly 750,000 cwts. valued at nearly £4,000,000, or nearly two-fifths, both by weight and by value, of the total exports of hides and skins, raw and tanned. Over two-thirds of these kips went to enemy countries, principally Germany and Austria-Hungary. The war has directed particular attention to this trade, and that not merely because of the difficulty of finding new buyers for the large quantities of kips suddenly shut off from their regular market. When converted into finished leather, kips are very suitable for use in making the uppers of stout boots, and they have been largely employed in Germany and Austria in the manufacture of army boots. At one time they were largely exported to the United Kingdom, but in the last two or three decades before the war the trade had passed into German hands. In India itself the merchant side of the business was controlled by German or quasi-German firms, who constituted a strong "ring." Ways and means of recapturing this trade, not only during the war but after the war, have been under careful consideration by an influential committee of the Imperial Institute, including representatives of British tanners and of Indian firms interested in the subject. A report was submitted by the Committee to the Secretary of State for India in March 1917. Important questions connected with the future development of other branches of the Indian trade in hides and skins have also been under consideration by this Committee.

The following article brings together statistical and other data relating to the subject in all its main branches. As a preliminary, an attempt is made to estimate the livestock resources of India, on which the supplies of hides and skins depend. The conditions and distribution of the trade are then discussed in detail, in relation both to the position existing before the war and developments during the war. One of the most notable features in this last connection is the development of the tanning industry in India. As already pointed out, in 1913–14 tanned hides and skins formed 16 per cent. of the total exports of hides and skins by weight, and 27 per cent. by value. In 1917–18 they formed 32 per cent. by weight

and 45 per cent. by value. In view of the marked differences between the British and foreign purchases of tanned and raw hides and skins before the war, it is obvious that the development of the tanning industry in India may have an important bearing on the future course of the trade.

Livestock Resources of India

British India.—Statistics of the livestock in British India are based mainly on provincial censuses. In some provinces livestock censuses are taken annually, in others only once in five years, and then not in the same year in all cases, though efforts are being made to secure greater uniformity in this respect. Meanwhile such totals as are available combine the returns for different years, and obviously no useful comparisons can be drawn from year to year. In Bengal no livestock census was taken till 1912–13, and then it covered only cattle and buffaloes. The latest figures for British India are given in *Agricultural Statistics*, 1916–17 (Calcutta, 1918; No. 583). The following table summarises the livestock returns :

Province.	Bulls and Cows.	Buffalo Bulls and Cows.	Calves and Buffalo Calves.	Sheep.	Goats.	Horses, Mules, Donkeys, Camels.
Bengal (1912–13)	15,998,100	942,656	8,383,168	—	—	—
Madras (1914–15)	12,130,209	3,751,386	5,878,807	10,765,543	7,426,828	188,623
Bombay (1915–16)	5,158,708	1,304,761	2,742,641	1,699,196	2,338,478	211,971
Sind (1915–16)	1,324,493	289,016	565,468	514,463	1,101,487	318,906
United Provinces (1914–15)	17,467,254	4,670,486	9,603,089	2,794,605	9,881,611	845,617
Bihar and Orissa (1913–14)	12,338,528	2,280,703	5,479,237	1,168,709	5,372,656	203,127
Punjab (1913–14)	8,258,150	3,189,683	4,041,250	4,676,899	4,431,837	1,472,015
Burma (1916–17)	3,801,142	856,597	1,641,292	38,777	198,303	110,686
Central Provinces (1916–17)	5,884,995	1,119,072	2,719,650	268,752	980,974	140,193
Berar (1916–17)	1,375,788	265,887	528,890	137,128	369,545	48,437
Assam (1914–15)	2,142,476	347,320	1,086,380	11,650	509,742	15,004
N.W. Frontier Prov. (1913–14)	795,087	175,015	300,958	604,004	543,308	211,176
Ajmer-Merwara (1916–17) *	202,020	44,400	52,002	234,094	184,570	9,895
Delhi (1914–15)	70,755	21,863	55,013	9,504	22,129	12,944
Coorg (1914–15)	81,200	19,677	33,147	110	3,929	291
Manipur (1916–17)	4,150	1,225	1,226	24	995	109
Total	87,033,055	19,279,747	43,112,218	22,923,458	33,366,392	3,788,994

Of the total of 87,000,000 cattle shown in the preceding table, the greater part, 49,400,000 (57 per cent.),

were bulls and bullocks, and 37,600,000 (43 per cent.) were cows. On the other hand, of the 19,300,000 buffaloes, only 5,600,000 (29 per cent.) were bulls, while 13,700,000 (71 per cent.) were cows.[1] The numbers of calves and buffalo calves are not given separately in *Agricultural Statistics of India*. If it may be assumed that they are in proportion to the numbers of full-grown cattle and buffaloes, then the total of 43,100,000 calves and buffalo calves would comprise about 35,300,000 calves and 7,800,000 buffalo calves. On this basis the total number of cattle in British India would be over 122,000,000 and of buffaloes over 27,000,000.

The chief cattle provinces are the United Provinces (20 per cent. of the full-grown animals), Bengal (18 per cent.), Bihar and Orissa (14 per cent.), Madras (14 per cent.), and the Punjab (9 per cent.), these five provinces containing three-fourths of the total. The chief buffalo provinces are the United Provinces (24 per cent.), Madras (19 per cent.), Punjab (17 per cent.), and Bihar and Orissa (12 per cent.), these four provinces containing nearly three-fourths of the whole. Bengal, which is the second largest cattle province, comes seventh in the list of provinces arranged according to numbers of buffaloes.

No figures are available as to the numbers of the smaller classes of livestock in Bengal. Among the other provinces of British India, Madras easily leads in respect of sheep, containing nearly half the recorded total. With those of Madras, the flocks of the Punjab and the United Provinces form nearly four-fifths of the total. In respect of goats, as of cattle and buffaloes, the United Provinces take first place with nearly one-third (30 per cent.) of the recorded total, while Madras, Bihar and Orissa, and the Punjab together account for more than half the total.

The 3,789,000 horses, mules, donkeys and camels consist mostly of horses and ponies (1,681,000) and donkeys (1,537,000). There are 500,000 camels, and 71,000 mules. Of the horses and ponies, well over half are found in the United Provinces (515,697), and the Punjab

[1] Buffalo bulls are apt to be dangerous, and Sir George Watt in his *Commercial Products of India* (Murray, 1908), notes on p. 736 that they are not often reared, but are either purposely starved or killed.

(427,515). In the same provinces are found nearly two-thirds of the donkeys, and nearly three-fourths of the mules. The Punjab alone has over three-fifths of the camels, most of the remainder being found in Sind and the N.W. Frontier Province.

Native States.—Livestock returns are made by eighteen Native States, with a total area of 165,000 sq. miles (about one-sixth of British India), and a population of 20,000,000 (about one-twelfth of that of British India). The number of livestock recorded in these States (22·7 millions) is about one-tenth of the number in British India (209·5 millions, exclusive of sheep, goats, etc., in Bengal). The following table gives the latest figures for the reporting States, as recorded in *Agricultural Statistics of India*, 1914–15, vol. ii.

State (1914–15).	Bulls and Cows.	Buffalo Bulls and Cows.	Calves and Buffalo Calves.	Sheep.	Goats.	Horses, Mules, Donkeys, Camels.
Mysore .	3,213,212	564,240	1,238,368	2,738,199	1,762,036	79,778
Central India:						
Gwalior .	1,777,816	394,756	1,124,101	202,948	533,165	101,558
Indore .	622,370	139,465	233,010	42,142	167,615	25,814
Bhopal .	446,161	114,348	9,131	14,634	18,899	22,149
Rajputana:						
Bikaner .	199,243	26,821	90,048	664,590	104,840	38,954
Marwar .	209,305	27,784	109,905	477,061	272,866	15,787
Jaipur .	265,165	80,291	92,960	203,967	249,869	23,027
Alwar .	283,800	85,726	161,573	253,704 [2]		22,590
Bharatpur	202,332	85,033	148,455	41,682	125,426	23,564
Tonk .	170,405	35,173	66,710	35,019	46,299	9,818
Kotah .	420,471	92,746	259,756	40,098	205,351	25,925
Others [1] .	500,741	129,643	253,725	227,479 [3]		21,052
Total .	8,311,021	1,776,026	3,787,742	8,427,889 [4]		410,016

[1] *Seven—namely, Rajgarh, Narsingarh, Barwani and Nagod in Central India; Kishangarh and Jhalawar in Rajputana; and Cochin.*

[2] *About* 200,000 *goats.* [3] *About* 144,000 *goats.*

[4] *About* 4,597,000 *sheep and* 3,831,000 *goats.*

The total in the last column is composed of 180,445 horses and ponies, over one-third of which are in Gwalior; 171,391 mules and donkeys, of which over one-third are in Mysore; and 58,180 camels, of which 35,000 are in Bikaner.

There is not much difference between the recorded numbers of bulls and bullocks (4,002,000) on the one hand and of cows (4,309,000) on the other; but the

excess of buffalo cows (1,528,500) over buffalo bulls (247,500) is very marked, the proportion being six to one. If the numbers of calves and buffalo calves are in the same proportion as the numbers of the adult animals in their respective classes, the young stock would comprise about 3,121,000 calves and 667,000 buffalo calves. On this basis the total number of cattle in the reporting Native States would be 11,432,000 and the total number of buffaloes 2,443,000.

Estimated Totals.—The reporting Native States comprise 21 per cent. of the total area of the Native States in India, and 27·5 per cent. of the total population. If the remaining States carried livestock on the same scale in proportion to area, the number of cattle in the Native States as a whole would be in round figures 54,500,000, the number of buffaloes 11,500,000, the number of sheep 22,000,000, the number of goats 18,250,000, the number of horses and ponies 850,000, and the number of mules and donkeys 800,000. On this basis the total numbers of the livestock in India as a whole (exclusive of sheep, goats, etc., in Bengal) would be: cattle, 177,000,000; buffaloes, 39,000,000; sheep, 45,000,000; goats, 52,000,000; horses and ponies, 2,500,000; mules and donkeys, 2,400,000.

Obviously there is room for a considerable margin of error in these estimated totals. As the non-reporting Native States are more sparsely populated than the reporting States, it may be that the former do not carry all classes of livestock on the same scale, in relation to area, as the latter. Proportionately, cattle may be fewer and sheep and goats more numerous, owing to the larger areas for grazing by flocks. In any case it is probable that the returns supplied by the reporting States are incomplete. In the crop-reporting Native States, which are much more numerous than the States which furnish livestock returns, statistics are available for less than half the total area. It is not stated in *Agricultural Statistics of India* what, if any, is the degree of incompleteness in the livestock returns from reporting Native States. The omissions, however, may easily balance any over-estimation in the above totals. For example, an

independent estimate of the number of sheep in India puts the total at between 50,000,000 and 55,000,000. If this be correct, the figure given above (45,000,000 outside of Bengal) is under rather than over the mark.

In the next table the calculated totals for India are shown, with the official returns for other leading countries. These official returns, like the official returns for India, are probably incomplete in some cases; but two things stand out clearly—that India has the largest number of livestock, and that British and Allied countries largely control the world's supply.

Country.	Millions of							
	Cattle.	Buffaloes.	Sheep.	Goats.	Horses.	Mules and Donkeys.	Pigs.	Total.
India	177·0	39·0	45·0	52·0	2·5	2·4	—	318
Australia (1916)	10·0	—	72·9	—	2·4	—	0·9	86
S. African Union (1911)	5·8	—	33·5 [1]	11·8 [1]	0·7	0·4	1·1	53
New Zealand (1917)	2·6	—	25·3	—	0·4	—	0·3	29
Canada (1917)	7·9	—	2·4	—	3·4	—	3·6	17
United Kingdom (1917)	12·3	—	27·8	—	1·9 [2]	—	3·0	45
United States (1918) [3]	66·8	—	48·9	—	21·6	4·8 [4]	71·4	213
Russian Empire (1914)	52·1	—	72·3	—	35·0	—	15·0	174
Brazil (1916)	29·0		7·2	6·9	6·1	3·2	17·3	70
Uruguay (1908)	8·2 [5]	—	26·3	—	0·6	—	0·2	35
France (1917) [6]	12·4	—	10·6	—	2·3	0·5	4·2	30
Italy (1914)	6·6		13·8		2·2		2·7	25
Argentina (1914)	25·9	—	43·2 [7]	4·3	8·3	0·8	2·9	85
Spain (1916)	3·1	—	16·0	3·2	0·5	1·8	2·8	27
Germany (1915)	20·3 [8]	—	5·1 [8]	3·4	3·3 [9]	—	17·3 [8]	49
Austria-Hungary [10]	17·8		12·4	3·1	4·3	0·7	14·9	53

[1] *At the end of* 1916 *the number of sheep in the Union of South Africa was returned as* 31,980,705 *and the number of goats as* 8,961,696.

[2] *Horses for agriculture, mares for breeding, and unbroken horses.*

[3] *Farm animals. In addition, at the census of* 1910, *animals not on farms numbered over* 7,000,000, *nearly half of them horses.*

[4] *Mules.*

[5] *In* 1916 *the number of cattle in Uruguay was returned as* 7,800,000.

[6] *Farm animals. Exclusive of invaded area.*

[7] *Census returns. At the previous census* (1908) *the number of sheep in Argentina was returned as* 67,384,000, *and at the end of* 1913 *an official estimate put the number at* 81,485,000.

[8] *In* 1917 *the number of cattle in Germany was returned as* 21,462,071, *of sheep as* 6,167,469, *and of swine as* 2,763,610.

[9] *Exclusive of army horses.*

[10] *Returns for years ranging from* 1910 *to* 1913 *for different parts of the Austro-Hungarian Empire.*

Numbers are not the only criterion of importance. The economic value of the livestock in India is limited by the small size of the animals, and the aversion of the

Hindus from taking life. The hides are not only light in weight, but are mostly taken from old and worn animals which have died a natural death. These and other fundamental considerations are opposed to the development of the livestock industry in India along the lines pursued by other countries. A certain amount of improvement in the stock is being effected by the efforts of the Veterinary Department, and, apart from this, it may be possible even under present conditions to remedy some of the worst defects in the preparation of the hides and skins for export. The subject is dealt with more fully in subsequent sections, under the heads of the several branches of the export trade. First, however, a brief survey may be taken of the import trade.

Imports of Hides and Skins into India

Though not commensurate with the exports, the imports of hides and skins into India amount to a considerable total. Including the imports across the land frontier, they attained in 1913–14 to a value of £635,000.

Sea-borne Trade.—Imports by sea provided less than one-third of the value of the total imports in 1913–14, (£203,556). The sea-borne trade had been increasing in value for some years before the war, and though there was a falling-off in 1914–15 (£144,859) and 1915–16 (£180,484), the pre-war value was exceeded both in 1916–17 (£246,281), and in 1917–18 (£254,273). In quantity the imports in the four war years were respectively 27,462 cwts., 32,692 cwts., 43,816 cwts. and 35,351 cwts. Prior to the war they amounted to between 30,000 cwts. and 40,000 cwts. annually, with a tendency to increase. In the five years 1909–10 to 1913–14, the average annual imports were 34,414 cwts. The value of these imports before the war was divided almost equally between raw hides and skins (£101,066 in 1913–14) and tanned hides and skins (£102,490 in 1913–14). It follows that the bulk of the trade by weight was in raw hides and skins; these provided imports to the amount of 32,906 cwts. in 1913–14, compared with imports of tanned hides and skins to the amount of 4,776 cwts., the total imports for the year being 37,682 cwts.

The greater part of the imports of raw hides and skins are drawn from countries in the British Empire (chiefly Aden, Ceylon, and the Straits Settlements), with Persia as the chief source of supply among foreign countries. The imports of tanned hides and skins are received almost exclusively from British countries, chiefly the United Kingdom. The great bulk of the raw imports, as regards both weight and value, consists of skins. The weight of the tanned imports is more evenly divided between hides and skins, though here again the skins predominate in value. In 1913–14 the figures were as follows :

Sea-borne Imports of Hides and Skins into India in 1913–14

Imports.	Quantity.			Value.
	British.	Foreign.	Total.	
	Cwts.	*Cwts.*	*Cwts.*	£
Raw hides . . .	2,146	1,875	4,021	10,935
Raw skins . . .	15,754	13,131	28,885	90,131
Total Raw . . .	17,900	15,006	32,906	101,066
Tanned hides . . .	2,164	54	2,218	24,078
Tanned skins . . .	2,256	302	2,558	78,412
Total Tanned . . .	4,420	356	4,776	102,490
Total Raw and Tanned .	22,320	15,362	37,682	203,556

There were no re-exports of raw hides and skins in 1913–14, and the re-exports of tanned hides and skins amounted to only 8 cwts.

Transfrontier Trade.—In the Indian transfrontier trade in hides and skins the relation between imports and exports is the reverse of that which obtains in the sea-borne trade. By sea, the imports are only a small fraction (less than 2 per cent.) of the exports, whereas by land the exports are a small fraction of the imports. As previously stated, the exports by sea, with a pre-war value of over £10,000,000 sterling, are the outstanding factor in the total trade in hides and skins ; but imports by land in 1913–14 formed a substantial item, valued at £431,980. At some of the Customs stations along the frontier quantities are reported by weight, and at others by numbers of hides and skins. In 1913–14 the imports recorded by weight amounted to 87,657 cwts., and those

recorded by number to 528,158. By far the greater part of the total, both in quantity and in value, consists of hides; they furnished over 80 per cent. of the total value in 1913–14.

Both in 1914–15 and again in 1915–16 the trans-frontier trade in hides declined considerably, but showed little further alteration in 1916–17. The transfrontier imports of skins, during the first three years of the war, were well maintained. The specification of the imports in the land trade returns is a little different from that in the returns of sea-borne trade. Imports by land are described as "Hides of Cattle" and "Skins of Sheep, Goats, and Small Animals," without its being definitely stated that they are raw hides and skins. There is no separate category under the heading "Leather"—as in the sea-borne trade returns—for tanned hides and skins, and if any imports of this description are included in the category "Unmanufactured Leather" they must be very small, the total imports so described in 1913–14 amounting in value to only £200.

In the returns of the "Trade by Land of British India with Foreign Countries" are included the imports from and the exports to a number of border States and territories within the international frontier of India, such as the Shan States (Burma), Swat and Waziristan (N.W. Frontier Province), Las Bela and Kalat (Baluchistan), and Sikkim. Some of this trade consists of goods in transit from remoter countries. In the report on the trans-frontier trade of Burma, for example, it is stated that this is the case in regard to the Shan States, etc. At present Customs stations are established only on the Indian border of these States; eventually it is hoped to establish stations on the outer or international border. Meanwhile it is impossible to give precise returns of the trade of British India with foreign countries only, as distinct from Indian Native States. The existing returns give the closest approximation possible under present conditions. With regard to the imports of hides, the chief source of supply is Nepal (nearly 40 per cent. of the total value in 1913–14). In the same year Dir, Swat, and Bajaur, on the Afghan border, were credited with

supplying nearly 21 per cent. of the total value, the Shan States 18 per cent., and Western China nearly 11 per cent. In other words, these four sources supplied 90 per cent. of the value of the hides imported into India by land in the latest year of normal trade. Of the skins imported by land, nearly 30 per cent. by value were received from Nepal, and over 50 per cent. from Afghanistan and bordering territories in the North-West Frontier Province.

Analysis of Export Trade

The exports of hides and skins from India by land are comparatively small (value £15,256 in 1913–14), and need not be considered in detail. This and following sections are concerned with the exports by sea.

The contributions made by the different classes of livestock to the Indian export trade in hides and skins are not equally related to their numbers. The number of grown cattle (cows and bulls) in India may be estimated from the data given in the section of this article relating to Livestock Resources at about 127,000,000. The number of raw and tanned cow-hides exported in 1912–13 was 13,214,430, and in 1913–14 it was 10,974,375; that is, the number of cow-hides exported before the war was from 8 to 10 per cent. of the estimated number of grown cattle in India. Similarly the total number of buffalo cows and bulls may be estimated at about 28,000,000, and before the war raw and tanned buffalo hides were exported to the extent of about 8 per cent. of this total—2,223,797 hides being exported in 1912–13 and 2,217,622 in 1913–14. Very much larger proportions of goat-skins and sheep-skins are exported. As already estimated, there are about 52,000,000 goats in India. The number of goat-skins exported annually before the war was as high as 55 per cent. of this total, amounting to 28,713,590 skins in 1912–13 and 28,266,207 skins in 1913–14. Of sheep it has been estimated that there are about 45,000,000; and about 25 per cent. of this number of sheep-skins were exported—11,999,181 in 1912–13, and 10,492,327 in 1913–14.

Altogether, between 50,000,000 and 60,000,000 hides and skins are exported annually from India under normal

trade conditions. Of these nearly two-thirds are raw, and the rest tanned. About half the total number are goat-skins, while most of the remainder are divided fairly evenly, as regards number, between cow-hides and sheep-skins. In 1916–17 the total number of hides and skins exported was nearly 67,000,000.

Weights and values afford a better basis than numbers for testing the relative importance of the different classes of hides and skins exported from India. The following table gives the returns for five years :

Exports of Hides and Skins in Cwts.

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
RAW HIDES :					
Cow . .	831,200	743,037	480,513	689,113	581,645
Buffalo . .	345,037	345,864	211,745	162,887	261,099
Calf . .	29,640	26,116	21,158	29,761	50,933
Other . .	3,172	730	510	124	351
Total quantity *cwts.*	1,209,049	1,115,747	713,926	881,885	894,028
,, value . .	£5,372,407	5,530,638	3,500,693	4,523,590	4,994,675
RAW SKINS :					
Goat . .	520,954	453,356	382,060	399,951	521,808
Sheep . .	31,668	33,067	26,295	32,517	45,134
Other . .	2,649	140	93	229	104
Total quantity *cwts.*	555,271	486,563	408,448	432,697	567,046
,, value . .	£2,447,576	2,260,244	1,695,583	1,995,184	4,603,416
TANNED HIDES :					
Cow . .	215,429	158,383	191,565	247,380	286,210
Buffalo . .	17,004	15,545	25,261	24,234	32,178
Other . .	830	100	194	388	4,002
Total quantity *cwts.*	233,263	174,028	217,020	272,002	322,390
,, value . .	£1,363,278	1,058,575	1,606,649	2,041,582	2,980,822
TANNED SKINS :					
Goat . .	61,741	74,126	61,288	70,773	83,861
Sheep . .	60,355	49,652	45,978	49,345	66,254
Others . .	8,311	6,815	10,139	7,204	12,804
Total quantity *cwts.*	130,407	130,593	117,405	127,322	162,919
,, value . .	£1,705,055	1,758,591	1,552,269	1,699,177	3,231,056
HIDES AND SKINS :					
Raw . .	1,764,320	1,602,310	1,122,374	1,314,582	1,461,074
Tanned . .	363,670	304,621	334,425	399,324	485,309
Total . . .	2,127,990	1,906,931	1,456,799	1,713,906	1,946,383
RAW AND TANNED :					
Hides . .	1,442,312	1,289,775	930,946	1,153,887	1,216,418
Skins . .	685,678	617,156	525,853	560,019	729,965
Total quantity *cwts.*	2,127,990	1,906,931	1,456,799	1,713,906	1,946,383
,, value . .	£10,888,316	10,608,048	8,355,194	10,259,533	15,809,969

During the period covered by the above table, about two-thirds of the raw hides by weight consisted of cow-hides in each year except 1915–16, when the proportion jumped up to 78 per cent. All but 2 or 3 per cent. of the remaining raw hides consisted of buffalo-hides in each year except 1916–17, when calf-skins formed 6 per cent. of the total. The percentage value of the raw cow-hides was a few units higher than their percentage weight.

Of the raw skins, goat-skins formed in each year from 92 to 94 per cent. of the total, and sheep-skins practically the whole of the remainder. The percentage values were about the same as the percentage weights.

Of the tanned hides, cow-hides formed from 88 to 92 per cent. of the total and buffalo-hides practically the whole of the remainder. The percentage value of the cow-hides was slightly higher than the percentage weight.

Of the tanned skins, goat-skins formed from 47 to 57 per cent. of the total, and sheep-skins from 38 to 46 per cent., leaving from 5 to 9 per cent. for "other kinds." The percentage value of the goat-skins (51 to 61 per cent.) was higher than their percentage weight.

The changes produced by the war assumed a more radical character in the year 1917–18. In the United Kingdom a proclamation dated February 23rd, 1917, prohibited as from that date the importation, except under licence, of numerous classes of goods, including wet and dry hides and dressed and undressed leather. In India the Government stopped the issue of licences for the export of cow-hides to the United Kingdom on private account. The tanning of goat and sheep-skins in the Madras and Bombay Presidencies was also prohibited (May 1917), so as to concentrate effort on the tanning of hides for War Office requirements, and to conserve for that purpose the supplies of suitable tanning bark. As a result, the exports of tanned cow-hides from India in 1917–18 increased to 342,806 cwts., while the exports of tanned goat-skins and tanned sheep-skins dropped sharply to 15,303 cwts. and 15,895 cwts. respectively.

The exports of raw cow-hides likewise declined to 317,588 cwts., so that for the first time the exports of tanned kips exceeded the weight of the raw kips exported. Raw buffalo hides dropped to 84,900 cwts. The exports of raw goat-skins were less affected, amounting to 392,034 cwts. The total exports of hides and skins were 1,245,923 cwts., valued at £9,450,067—the lowest quantity, but not the lowest value, recorded during the war. The total was composed of 846,931 cwts. of raw hides and skins, and 398,992 cwts. of tanned hides and skins; or, otherwise grouped, 779,577 cwts. of raw and tanned hides, and 466,346 cwts. of raw and tanned skins. The significance of these figures, in relation to those of earlier years, will be apparent from the following tables of percentages.

The percentage relation of hides and skins by weight in the export trade is shown in the following table:

Percentage Exports, Hides and Skins, by Weight

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.	1917–18.
Raw hides	69	70	64	67	61	49
„ skins	31	30	36	33	39	51
	100	100	100	100	100	100
Tanned hides	64	57	65	68	66	91
„ skins	36	43	35	32	34	9
	100	100	100	100	100	100
Total hides	68	68	64	67	62·5	63
„ skins	32	32	36	33	37·5	37
	100	100	100	100	100	100

The proportion of hides to skins is usually about the same in the raw and in the tanned exports, and consequently in the total export trade. The weight of hides exported is about twice the weight of skins, and this proportion was not greatly affected in the case of the totals even in 1917–18, when the decrease in the percentage weight of raw hides was counterbalanced by the increase in the percentage weight of tanned hides. It is instructive to contrast with the above the percentage relation of hides and skins by value:

Percentage Exports, Hides and Skins, by Value

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.	1917–18
Raw hides .	69	71	67	69	52	39
,, skins .	31	29	33	31	48	61
	100	100	100	100	100	100
Tanned hides	44	38	51	55	48	77
,, skins	56	62	49	45	52	23
	100	100	100	100	100	100
Total hides .	62	62	61	64	50·4	56
,, skins .	38	38	39	36	49·6	44
	100	100	100	100	100	100

The percentage values were not much different from the percentage weights in the case of raw hides and skins, except in 1916–17 and 1917–18, when the percentage value of raw skins was considerably greater than their percentage weight. In other words, raw hides and raw skins, as valued for export purposes, are normally about the same price per cwt., but in 1916–17 and 1917–18 raw skins fetched a much higher price than raw hides. On the other hand, the percentage value of the tanned skins was much higher than their percentage weight in each of the six years covered by the table; so much so that while the tanned skins usually amounted, in weight, to little more than half the tanned hides, their value was greater than that of the tanned hides in three years out of the six. Analysis of the percentage relation between the raw and tanned exports is also instructive:

Percentage Exports, Raw and Tanned Products, by Weight

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.	1917–18.
Raw hides .	84	86·5	77	76	73·5	54
Tanned hides	16	13·5	23	24	26·5	46
	100	100	100	100	100	100
Raw skins .	81	79	78	77	78	92
Tanned skins	19	21	22	23	22	8
	100	100	100	100	100	100
Total, Raw,	83	84	77	77	75	68
,, Tanned	17	16	23	23	25	32
	100	100	100	100	100	100

Before the war tanned hides constituted, by weight, about one-sixth or one-seventh of the total hides exported, and tanned skins about one-fifth of the total skins exported. In the five years, 1912–13 to 1916–17, the proportion of tanned skins among the skins exported did not greatly increase (from 19 to 22 per cent.), and in 1917–18 it dropped to 8 per cent., owing to the Government restrictions already noted. Among the hides, on the other hand, the proportion of the tanned hides increased during the six years from 16 to 46 per cent., the rise being especially marked in 1917–18, due to the Government measures to promote the output of tanned kips. Among hides and skins combined, the tanned goods increased during the period covered by the table from 17 to 32 per cent. of the total. Except in 1916–17, the actual exports of tanned hides and skins as a whole were not greatly in excess of the pre-war figures, and the percentage increase has been chiefly due to the decline in the exports of raw hides and skins, more particularly raw hides. This decline is directly due to the war, and from the standpoint of Indian industry the question is whether after the war the exports of raw hides will expand again at the expense of trade in the tanned product.

The following table shows the percentage values of the raw and tanned exports :

Percentage Exports, Raw and Tanned Products, by Value

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.	1917–18.
Raw hides .	80	84	69	69	63	39
Tanned hides .	20	16	31	31	37	61
	100	100	100	100	100	100
Raw skins .	59	56	52	54	59	76
Tanned skins .	41	44	48	46	41	24
	100	100	100	100	100	100
Total, Raw .	72	73	62	64	61	55
,, Tanned .	28	27	38	36	39	45
	100	100	100	100	100	100

Among the exports of hides, the percentage value of the tanned products, like the percentage weight, has increased considerably during the war. The percentage

value of the tanned hides, naturally, is greater than the percentage weight, and has tended to increase more rapidly; in 1912–13 the percentage value was one-fourth greater than the percentage weight, while in 1917–18 it was one-third greater. On the other hand the percentage value of the tanned skins, though showing little increase or decrease till the abnormal drop in 1917–18, was about double the percentage weight of the tanned skins till the last-named year, when it was three times as great. After allowance has been made for abnormal conditions of supply and demand, it remains generally true that tanning in India increases the value of skins by weight very much more, relatively, than it does the value of hides. The explanation is not so much that the skins are tanned more completely than the hides, but, as will be seen later, that they lose relatively more in weight—at any rate as compared with kips. The increase in value per skin, as a result of tanning, is much more commensurate with the increase in value per hide than might be thought from a comparison of their respective increases in value by weight.

To recapitulate: By weight, in the normal course of trade, the exports of raw hides consist almost entirely of cow-hides and buffalo-hides, in the proportion of two to one; of the tanned hides exported, nine-tenths are cow-hides. Over nine-tenths of the raw skins exported are goat-skins, which also provide between half and three-fifths of the tanned skins exported; the remainder of both the raw and the tanned skins are chiefly sheep-skins. The weight of hides exported from India is about twice the weight of skins, as regards both raw and tanned products. Raw hides before the war were about the same price per cwt. as raw skins, but tanned skins fetched much higher prices per cwt. than tanned hides, with the result that the proportion of the total exports of hides to the total exports of skins by value was little more than three to two. In 1916–17 the two classes of exports were about equal in value, and in 1917–18 the proportion was about five to four. The weight of raw hides exported before the war was 5 or 6 times the weight of tanned hides; and the weight

of raw skins about four times the weight of tanned skins. Among the exports of skins the proportion was not greatly affected by the war till 1917–18, when it rose to about eleven to one; as regards hides, on the contrary, the proportion was steadily reduced till in 1917–18 the exports of raw hides were to the exports of tanned hides as about six to five, the weight of the tanned kips being actually greater than that of the raw kips.

So far the exports of hides and skins from India have been considered in their group relations. The following table shows, for the latest year of normal trade, the importance of the principal kinds of hides and skins exported, considered in relation to the whole:

Exports of Hides and Skins in 1913–14

	Quantity.		Value.	
	Cwts.	*Per cent.*	£	*Per cent.*
COW-HIDES:				
Raw	743,037	39·0	3,937,007	37·1
Tanned	158,383	8·3	982,654	9·3
Total	901,420	47·3	4,919,661	46·4
BUFFALO-HIDES:				
Raw	345,864	18·1	1,469,113	13·8
Tanned	15,545	0·8	75,127	0·7
Total	361,409	18·9	1,544,240	14·5
GOAT-SKINS:				
Raw	453,356	23·8	2,085,132	19·7
Tanned	74,126	3·9	1,073,767	10·1
Total	527,482	27·7	3,158,899	29·8
SHEEP-SKINS:				
Raw	33,067	1·7	173,999	1·7
Tanned	49,652	2·6	639,000	6·0
Total	82,719	4·3	812,999	7·7
OTHER HIDES AND SKINS:				
Raw [1]	26,986	1·4	125,631	1·2
Tanned [2]	6,915	0·4	46,618	0·4
Total	33,901	1·8	172,249	1·6
TOTAL HIDES AND SKINS	1,906,931	100·0	10,608,048	100·0
Hides, raw	1,115,747	58·5	5,530,638	52·1
Hides, tanned	174,028	9·1	1,058,575	10·0
Skins, raw	486,563	25·5	2,260,244	21·3
Skins, tanned	130,593	6·9	1,758,591	16·6
Total hides and skins	1,906,931	100·0	10,608,048	100·0

[1] *Chiefly hides (calf-skins).* [2] *Chiefly skins.*

The great bulk of the trade consisted of cow-hides, buffalo-hides and goat-skins, which together constituted 94 per cent. of the total by weight and 91 per cent. by value. Cow-hides alone furnished nearly half the total both by weight and by value, goat-skins over one-fourth, and buffalo-hides nearly one-fifth by weight (one-seventh by value). Of the cow-hides over one-sixth were tanned, and of the goat-skins one-seventh, but of the buffalo-hides only about 4 per cent.

The relatively small contribution which sheep-skins make to the total is noteworthy, seeing that the estimated number of sheep in India is not greatly different from the number of goats. The numbers are roughly in the proportion of nine sheep to ten goats, but the exports of sheep-skins are only about one-sixth of the exports of goat-skins by weight. This statement is true not only for 1913–14, but for each of the five years ending 1916–17. During that period the proportion showed a slight tendency to increase, but in 1917–18 it dropped to one-eighth. The disparity is partly due to the fact that the average sheep-skin exported is of lighter weight than the average goat-skin; but, even on the basis of numbers, between two or three times as many goat-skins as sheep-skins are annually exported from India. The position occupied by sheep-skins is further noteworthy in that, ordinarily, well over half the exports of this class of skins are tanned, whereas among the exports of cow-hides, buffalo-hides, calf-skins, and goat-skins, the raw product greatly preponderates in every case.

A small addition to the trade is furnished by cuttings of raw hides and skins, which in 1913–14 were exported to the amount of 29,488 cwts., valued at £24,394. Of these cuttings 90 per cent. were despatched from Bengal. The great bulk of them went to the United States. During the war the trade in cuttings has declined, the exports in 1917–18 amounting to only 5,661 cwts., valued at £4,488.

The distribution of the exports by groups and as a whole is shown in the following tables. The italicised figures bracketed with the chief items denote percentages.

Exports of Raw Hides

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	1,209,049	1,115,747	713,926	881,885	894,028
,, value .	£5,372,407	5,530,638	3,500,693	4,523,590	4,994,675
To British Countries :	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom	83,799 / 6·9	42,365 / 3·8	132,322 / 18·5	99,290 / 11·3	145,140 / 16·2
Canada . .	5,302	9,021	2,261	11,079	12,848
Others [1] . .	5,367	5,805	1,114	5,656	4,470
Total . .	94,468 / 7·8	57,191 / 5·1	135,697 / 19·0	116,025 / 13·2	162,458 / 18·2
To Allied Countries :					
United States .	228,281 / 18·9	155,372 / 13·9	189,173 / 26·5	312,968 / 35·5	461,167 / 51·6
Italy . .	133,164 / 11·0	106,805 / 9·6	72,199 / 10·1	383,360 / 43·5	172,871 / 19·3
France . .	25,584	17,885	8,619	21,924	37,562
	—	—	—	—	4·2
Belgium . .	21,417	21,888	6,852	—	—
Others [2] . .	3,793	3,503	4,722	614	4,105
Total . .	412,239 / 34·1	305,453 / 27·4	281,565 / 39·5	718,863 / 81·5	675,705 / 75·6
To Enemy Countries :					
Germany .	389,429 / 32·2	388,409 / 34·8	146,575 / 20·5	— / —	— / —
Austria-Hungary	173,772 / 14·4	237,829 / 21·3	60,143 / 8·4	— / —	— / —
Turkey . .	24,609	33,095	10,849	—	—
Bulgaria . .	5,649	2,663	4,690	—	—
Total . .	593,459 / 49·1	661,996 / 59·3	222,257 / 31·1	— / —	— / —
To Neutral Countries :					
Spain . .	65,946 / 5·5	49,375 / 4·4	47,011 / 6·6	29,552 / 3·4	41,317 / 4·6
Holland . .	42,624 / 3·5	41,564 / 3·7	5,518 / 0·8	— / —	— / —
Sweden . .	—	—	19,526	6,564	—
Norway . .	125	83	2,243	10,353	13,861
Others . .	188	85	109	528	687
Total . .	108,883 / 9·0	91,107 / 8·2	74,407 / 10·4	46,997 / 5·3	55,865 / 6·2

[1] *Chiefly Ceylon and Straits Settlements.* [2] *Chiefly Rumania and Greece.*

The total exports of raw hides in 1917–18 amounted to 417,903 cwts., valued at £2,057,092. No returns of the distribution of the trade in hides and skins in that year are available for publication.

There has been a considerable increase in the exports of raw hides to the United Kingdom during the war. Germany and Austria-Hungary were the chief customers

before the war, and were followed by the United States and Italy. During the war the last two countries have absorbed some of the supplies which would have gone normally to enemy countries, but the loss of enemy markets has been attended by a heavy falling off in the total exports, due in part to the shortage of shipping and the restrictions on trade.

Before the war nearly 80 per cent. of the exports of raw hides were shipped from Bengal ports, the remainder being despatched almost entirely from the ports of Sind (9 per cent.) and Burma (10 per cent.). In 1916–17 the share of Bengal had dropped to 63 per cent., and that of the Sind ports had risen to 21 per cent., while 7 per cent. were shipped from Bombay ports; the share of Burma remaining fairly normal at 9 per cent. In 1917–18, however, Bengal's share was up again to 73 per cent., that of Sind being 10 per cent., of Bombay 6 per cent., and of Burma 10 per cent.

Exports of Raw Skins

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	555,271	486,563	408,448	432,697	567,046
„ value	£2,147,576	2,260,244	1,695,583	1,995,184	4,603,416
To British Countries:	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom	57,598	41,993	39,722	33,993	40,719
	10·4	*8·6*	*9·7*	*7·9*	*7·2*
Others [1] . .	6,937	3,389	3,168	5,557	7,526
Total . .	64,535	45,382	42,890	39,550	48,245
	11·6	*9·3*	*10·5*	*9·1*	*8·5*
To Allied Countries:					
United States .	411,415	371,270	325,358	385,401	495,855
	74·1	*76·3*	*79·7*	*89·1*	*87·4*
France . .	35,944	22,802	8,685	7,573	21,893
	6·5	*4·7*	*2·1*	*1·75*	*3·9*
Others [2] .	6,186	9,088	9,902	173	1,053
Total . .	453,545	403,160	343,945	393,147	518,801
	81·7	*82·9*	*84·2*	*90·9*	*91·5*
To Enemy Countries:					
Total [3] .	14,954	14,179	7,957	—	—
	2·7	*2·9*	*2·0*		
To Neutral Countries:					
Total [4] .	22,237	23,842	13,656	—	—
	4·0	*4·9*	*3·3*	—	—

[1] *Chiefly Australia.* [2] *Chiefly Belgium, up to and including* 1914–15
[3] *Chiefly Germany.* [4] *Chiefly Holland.*

In 1917–18 the total exports of raw skins amounted to 429,028 cwts., valued at £3,163,716.

The British share of the trade in raw skins, as in raw hides, is small, though the United Kingdom is the largest buyer after the United States. The latter country is the dominating power in this branch of Indian trade, taking three-fourths of the exports before the war and nearly nine-tenths both in 1915–16 and in 1916–17.

The shipping of skins is more evenly divided among the provinces of India than the shipping of hides, but shows the same war tendency, namely the declining importance of Bengal ports, and the transference of trade to the ports of Bombay and Sind, up to and including 1916–17, with partial recovery on the part of Bengal in 1917–18. In 1916–17 the shipments of raw skins from Bengal ports were 26 per cent. against 43 per cent. in 1913–14; from Bombay ports they were 35 per cent. against 28 per cent.; and from Sind ports, 34 per cent. against 23 per cent. In 1917–18 the percentages were: Bengal, 35; Bombay, 33; Sind, 25. The rest (5 or 6 per cent.) of the raw skins are despatched almost entirely from Madras ports.

Exports of Tanned Hides

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	233,263	174,028	217,020	272,002	322,390
„ value	£1,363,278	1,058,575	1,606,649	2,041,582	2,980,822
To British Countries:	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom	229,075 / 98·2	169,687 / 97·5	214,115 / 98·7	270,648 / 99·5	321,121 / 99·6
Others . .	3,145	1,646	784	1,354	1,250
Total . .	232,220 / 99·5	171,333 / 98·5	214,899 / 99·0	272,002 / 100	322,371 / 100
To Foreign Countries:	1,043	2,695	2,121	—	19

In 1917–18 the total exports of tanned hides were 361,674 cwts., valued at £3,246,588.

Tanned hides were exported exclusively to British countries in 1915–16, and all but so in 1916–17, the great bulk going to the United Kingdom. The position was little different before the war, only 0·5 per cent. of the total being exported to foreign countries in 1912–13, and

1·5 per cent. in 1913–14. Normally, four-fifths of the total are despatched from Madras ports, and practically all the remainder from Bombay ports.

Exports of Tanned Skins

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	130,407	130,593	117,405	127,322	162,919
„ value	£1,705,055	1,758,591	1,552,269	1,699,177	3,231,056
TO BRITISH COUNTRIES:	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom	99,879 / *76·6*	102,442 / *78·4*	92,698 / *79·0*	83,575 / *65·6*	107,451 / *66·0*
Straits Settlements	2,490	1,719	1,766	1,775	1,746
Others . .	350	606	378	594	426
Total . .	102,719 / *78·8*	104,767 / *80·2*	94,842 / *80·8*	85,944 / *67·5*	109,623 / *67·3*
TO ALLIED COUNTRIES:					
United States .	16,032 / *12·3*	16,211 / *12·4*	13,135 / *11·2*	35,452 / *27·8*	46,139 / *28·3*
Japan . .	9,146 / *7·0*	7,491 / *5·7*	8,612 / *7·3*	5,840 / *4·6*	6,537 / *4·0*
Others [1] . .	92	329	91	65	616
Total . .	25,270 / *19·4*	24,031 / *18·4*	21,838 / *18·6*	41,357 / *32·5*	53,292 / *32·7*
TO GERMANY:	2,380 / *1·8*	1,785 / *1·4*	718 / *0·6*	—	—
TO OTHER FOREIGN COUNTRIES [2] .	38	10	7	21	4

[1] *France, Belgium, Siam.*
[2] *Holland, Sumatra, and other foreign countries not specified.*

The total exports of tanned skins in 1917–18 amounted to only 37,318 cwts., valued at £982,671.

Tanned skins are not exported to British countries to the same extent as tanned hides; but before the war the United Kingdom received over three-fourths of the total exports of tanned skins, and British countries as a whole about four-fifths of the total. Most of the remainder went to the United States and Japan, the more important customer being the United States. In 1915–16 and 1916–17 the British proportion of the trade declined to about two-thirds, though the actual exports to British countries in 1916–17 were larger than in any other year of the quinquennium. The percentage decline of the British trade was due to the large increase in the exports of tanned

skins to foreign countries, the dominating factor being the exports to the United States, which increased from 16,000 cwts. in 1913–14 to 46,000 cwts. in 1916–17. As in the case of tanned hides, most of the trade in tanned skins is done from Madras, over four-fifths of the exports being despatched ordinarily from the ports of that presidency, and the rest mainly from Bombay ports.

The following table shows the distribution of the total exports of hides and skins in 1913–14 :

Exports of Hides and Skins, Raw and Tanned, in 1913–14

	Quantity.		Value.	
To British Countries:	*Cwts.*	*Per cent.*	£	*Per cent.*
United Kingdom . .	356,487	18·7	2,749,734	25·9
Other British countries .	22,186	1·2	122,307	1·2
Total . . .	378,673	19·9	2,872,041	27·1
To Allied Countries:				
U.S.A.	542,853	28·5	2,569,047	24·2
Italy	106,943	5·6	564,260	5·3
Other countries . .	81,983	4·3	441,402	4·2
Total . . .	731,779	38·4	3,574,709	33·7
To Enemy Countries:				
Germany . . .	402,988	21·1	2,151,887	20·3
Austria-Hungary . .	239,214	12·5	1,241,469	11·7
Other countries . .	35,758	1·9	95,531	0·9
Total . . .	677,960	35·5	3,488,887	32·9
To other Foreign Countries:	118,519	6·2	672,411	6·3
British	378,673	19·9	2,872,041	27·1
Allied	731,779	38·4	3,574,709	33·7
Enemy	677,960	35·5	3,488,887	22·9
Neutral	118,519	6·2	672,411	6·3
Total . . .	1,906,931	100	10,608,048	100·0

Both Allied and enemy countries were much larger buyers of Indian hides and skins of all kinds before the war than were British countries. The largest individual share of the trade, however, in respect of value, was that taken by the United Kingdom (over one-fourth), though in respect of quantity both the United States (over one-fourth) and Germany (over one-fifth) were ahead of the United Kingdom (under one-fifth). The next largest buyer, Austria-Hungary, had about one-eighth

of the trade. Between them these four countries took about four-fifths of the total exports, both by quantity and by value.

These comparisons do not take account of the re-export trade of the receiving countries. In the case of the United Kingdom, the re-export trade is of large dimensions, as the following returns show:

Trade of the United Kingdom in Indian Hides and Skins

	1912.	1913.	1914.	1915.	1916.
		RAW HIDES.			
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
Gross Imports .	148,212	100,019	92,033	160,491	141,004
Net Imports . .	81,819	48,131	56,667	84,545	74,948
	UNDRESSED GOAT-SKINS.				
	Number.	Number.	Number.	Number.	Number.
Gross Imports .	5,499,192	5,933,071	3,648,301	4,988,277	5,926,264
Net Imports . .	1,217,481	1,149,836	710,055	1,437,680	511,662
	OTHER UNDRESSED SKINS.				
	£	£	£	£	£
Gross Imports .	15,997	36,575	32,664	30,798	90,352
Net Imports . .	7,052	7,796	10,132	6,678	11,247
	LEATHER (MOSTLY ROUGH-TANNED HIDES AND SKINS)				
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
Gross Imports .	344,507	309,527	272,724	371,339	401,056
Net Imports .	261,832	220,290	206,806	326,145	304,938

Of the raw hides imported into the United Kingdom from India before the war, about one-half were retained; of the raw goat-skins, about one-fifth; of the other raw skins—a comparatively small item—nearly half in 1912 and a fifth in 1913; of the tanned hides and skins, about three-fourths. During the war, up to and including 1916, the proportion retained was subject to little alteration in the case of either raw hides or leather, but fluctuated considerably in the case of raw skins (see p. 226).

INDIAN TANNING INDUSTRY

Before dealing with the chief kinds of hides and skins separately, it will be useful to state the present position with regard to a question which affects the trade in all of them—the development of the tanning industry in India.

Factory Statistics.—In the factory statistics of India a distinction is drawn between tanneries and leather

works. Both are tabulated under " Processes connected with skins and hides," and most if not all of the leather works appear to comprise tanneries. A certain amount of tanning is done by individuals in almost every town and village in India, but factories of any considerable size devoted to this industry are not numerous. In the *Commercial Products of India* (Murray, 1908), Sir George Watt says that in 1902–3 there were 202 tanneries with 6,200 employees ; and of these tanneries 183 were small concerns, located in the Madras Presidency and engaged chiefly in the dressing of skins. The statistics now issued relate mainly to factories employing 50 persons or more. The returns distinguish not only between tanneries and leather works, but between those worked by mechanical or electrical power and those not so worked. In each category the number of employees as well as the number of works is given. During the decade ending 1915 (the latest year for which returns are available), the total number of works engaged in processes connected with hides and skins, including an occasional entry under " miscellaneous," increased in every year but one, and advanced from 19 in 1906 to 40 in 1915. The total number of employees fluctuated considerably, and was slightly less in 1915 (6,787) than in 1906 (6,930) ; in the interval it fell to a minimum in 1909 (5,862) and reached a maximum in 1914 (10,397). In each year the number of tanneries (16 to 28) was considerably in excess of the number of leather works (3 to 13), but the latter employed the larger number of persons prior to 1912, when tanneries claimed 6,175 employees against 2,488 employees in leather works. Tanneries continued to employ the larger number of persons both in 1913 and in 1914 ; but in 1915 leather works again took the lead, with 4,262 employees against 2,397 in tanneries. This preponderance of employees in leather works is due to the outstanding position of the Cawnpore works, run by mechanical power, which in 1915 had 3,649 employees (2,938 in Messrs. Cooper, Allen & Co.'s Army Boot and Equipment Factory), or over 53 per cent. of the total published number of employees in private leather works and tanneries throughout India. When account

is further taken of the employees in other leather works run by mechanical power, as well as in tanneries run by power, a very large proportion of the total number of employees is found to be absorbed by establishments of this description. In 1915 as many as 5,722 persons out of a total of 6,787 were employed in power works, and though the proportion was not always so large, in no year during the decade was it less than two-thirds. The number of establishments worked by power increased from 7 in 1906 to 17 in 1912, dropped to 14 in the following year, rose to 23 in 1914, and dropped again to 18 in 1915. The number of establishments not worked by mechanical or electrical power ranged during the decade between 16 and 22, and constituted a majority in each year except 1914. In other words, up to 1915, non-power establishments for the tanning and working of hides and skins were ordinarily the more numerous, but power establishments employed, both on average and as a whole, a much larger number of persons.

Not included in the returns just given is the Government Harness and Saddlery Factory at Cawnpore. Up to 1915 this was the only leather works or tannery under public ownership in India. The average number of persons employed there increased from 1,682 in the year before the war to 2,552 in 1915. Thus the total number of persons employed in India in 1915 on processes connected with hides and skins, so far as returns are available, was 9,339, and the number of works employing them was 41. It may be repeated that these are only the larger establishments of their kind, and that tanneries especially are very much more numerous. For instance, the returns which have been quoted include only one hides and skins factory for Mysore—a tannery at Bangalore employing 112 persons. But a report issued by the Mysore Department of Industries and Commerce on the foreign rail-borne trade of that State in 1916–17 gives the number of tanneries as 52; and an official statement issued in Madras towards the end of 1917 mentioned incidentally that there are several hundreds of tanneries in the Madras Presidency, Mysore, and Hyderabad.

The Madras Industry.—The majority of the larger tan-

neries in India before the war—as distinct from leather works, in which tanneries (where they exist) are associated with leather manufactures—were in the Madras Presidency. In 1908, out of 23 tanneries employing 3,813 persons, Madras contained 19, employing 2,200 persons. In 1913, out of 22 tanneries employing 2,622 persons, Madras contained 15, employing 1,396 persons. In 1915, however, out of 26 tanneries employing 2,397 persons, Madras had only 9, employing 900 persons; Bengal had a larger number (12), but they employed only 540 persons.

As already seen from the trade returns, Madras provides the great bulk of the exports of both tanned hides and tanned skins from India. Next to seeds, the most valuable exports from the Presidency are hides and skins, raw and tanned, and in the five years ending 1912–13, over 88 per cent. of the value of these exports was provided by tanned hides and skins. Though classed as leather, the tanned hides and skins exported are not the finished product, ready for manufacture. Sir George Watt states (*Commercial Products of India*, 1908, p. 637), that "protracted immersion [of hides and skins in process of being tanned] has for many years past been admitted as impossible in India." This may explain, in part, the "half process" employed by native tanners connected with the export trade, though the nature of the tanning materials in use is also an important factor. In the Madras *Handbook of Commercial Information* (Madras, 1916), by Mr. M. E. Couchman, I.C.S., Director of Industries, the exports of tanned hides and skins are described as "tanned (unfinished)," and in Flemming's *Practical Tanning* (Philadelphia, 1910) it is stated that India-tanned sheep-skins and goat-skins, as received from India, "are imperfectly tanned, of a dark colour and quite hard. In order to complete the tanning and to improve the quality of the leather by making it softer and better adapted for fancy colours, it is necessary to remove from it some of the original tanning material, and to replace it with one that makes soft and light-coloured leather." Flemming recognises, however, the excellent quality of these skins, which "have considerable firmness and

durability and yet are soft and pliable, and, when coloured and finished, cannot be excelled by any other leather." This bears out the opinion of the Madras Government Expert, who is quoted by Mr. Couchman as stating, with reference to the provincial industry of tanning for export, that " the methods employed by the export tanners, when carried out under the best conditions as regards water, bark, and myrobalams, and careful supervision, turn out a class of leather that is of very high quality, very suitable for European and American leather dressers, and although several tanners have at different times tried to modernise the processes used for these skins, they have always returned to the old native methods."

Pre-war Changes.—True as the foregoing may be, changing conditions in the world's markets had considerably affected the Madras tanning industry even before the war. European methods of tanning were introduced in the first half of the nineteenth century, and at one time almost all the hides and skins exported from the Presidency were tanned. This continued to be the case as regards hides, as will be seen from the following table, which shows the course of trade up to the outbreak of war :

Exports of Hides from Madras Presidency

Hides :	Average Annual Exports in Cwts.			
	Quinquennium 1895–6 to 1899–1900.	Quinquennium 1900–1 to 1904–5.	Quinquennium 1905–6 to 1909–10.	Four Years 1910–11 to 1913–14.
Raw . . .	96	1,068	714	2,083
Tanned . .	124,593	128,713	157,060	152,322
Total . .	124,689	129,781	157,774	154,405

Throughout the period covered by the above table the exports of tanned hides from Madras formed between 80 and 90 per cent. of the total exports of tanned hides from India. Though subject to large fluctuations from year to year, in its general trend the trade in tanned hides followed a fairly normal course of development, agreeing in this respect with the total exports of raw hides from India, in which Madras has quite an insig-

nificant share. The figures for India as a whole are shown in the following table:

Exports of Hides from India

Hides:	Average Annual Exports in Cwts.			
	Quinquennium 1895–6 to 1899–1900.	Quinquennium 1900–1 to 1904–5.	Quinquennium 1905–6 to 1909–10.	Four Years. 1910–11 to 1913–14.
Raw . . .	786,544	802,698	863,449	1,030,445
Tanned . .	144,724	144,580	180,769	183,745
Total . .	931,268	947,278	1,044,218	1,214,190

The course of the export trade in skins, during the two decades immediately prior to the war, was of a very different character, as regards both the Madras Presidency and India as a whole. While the exports of raw skins went up by leaps and bounds, the exports of tanned skins declined. In the Presidency, both tendencies received a check before the war, but in India as a whole they continued to operate up to the last year of normal trade. The following are the figures for Madras:

Exports of Skins from Madras Presidency

Skins:	Average Annual Exports in Cwts.			
	Quinquennium 1895–6 to 1899–1900.	Quinquennium 1900–1 to 1904–5.	Quinquennium 1905–6 to 1909–10.	Four Years 1910–11 to 1913–14.
Raw . . .	5,979[1]	42,557	67,832	36,524
Tanned . .	156,107	122,206	107,694	115,523
Total . .	162,086	164,763	175,526	152,047

[1] *The annual exports yielding this average were* 1,071 *cwts.*, 524 *cwts.* 276 *cwts.*, 6,535 *cwts.*, *and* 21,470 *cwts.*

Though not dominating the trade quite to the same extent as in the case of tanned hides, the exports of tanned skins from Madras form the great bulk of such exports from India (over three-fourths during the last twenty years before the war). On the other hand, the raw skins exported from Madras are only a small part

of the total trade. The following are the total figures for India :

Exports of Skins from India

Skins:	Average Annual Exports in Cwts.			
	Quinquennium 1895–6 to 1899–1900.	Quinquennium 1900–1 to 1904–5.	Quinquennium 1905–6 to 1909–10.	Four Years 1910–11 to 1913–14.
Raw . . .	120,139	266,723	480,649	531,240
Tanned . .	194,693	159,545	142,787	139,181
Total . .	314,832	426,268	623,436	670,421

Chrome Tanneries in Madras.—The growth in the exports of raw skins at the expense of the trade in tanned skins is due to the development abroad of chrome tanning, especially as practised in the United States for the production of glacé kid. The bulk of the raw skins exported before the war were consigned to the United States. Efforts to establish tanneries employing the chrome process in the Madras Presidency have attained some success in the last few years, though hitherto their influence on the export trade has not been great. The first experiments, in the early years of the present century, were not a commercial success, but those interested in the industry persevered, and two companies were established : the Chrome Leather Company, Madras, and the Mysore Tannery, Ltd., with works near Bangalore. After the early difficulties had been overcome, both companies made considerable and steady progress, and during the war a third chrome tannery has been established with local capital at Berhampur, near the extreme north-east corner of the Presidency. The Chrome Leather Company, Madras, which in 1916 employed a capital of about 9 lakhs (£60,000), has built a new tannery and factory at Pallavaram, a few miles south of Madras. Pallavaram was formerly the home of several tanneries which fell into decay with the development of the chrome tanning industry in the United States. About 1,000 men were engaged in 1916 in the Chrome Leather Company's new works. Apart from the production of chrome leather—comprising both sole and upper leathers, as well

as belting—bark-tanned sole leather of superior quality is turned out in considerable quantities. All classes of manufactured leather goods are produced, and large quantities of footwear and accoutrements have been supplied to the Government of India. When the *Madras Handbook of Commercial Information* was issued in 1916 considerable extensions were being made to the works with a view to the export of chrome-tanned upper and sole leathers on a large scale. The Mysore Tannery has been concentrating on the production of chrome-tanned black box sides for export, and the same class of goods is being produced by the Berhampur tannery for export via Calcutta.

Normally large quantities of raw hides and skins are bought in other parts of India and brought into Madras to be tanned, not only for export but for the home market. The best hides reach Madras from November to April. Skins are in the best condition from January to May, and buying stops to a large extent in the latter part of the hot weather, as the skins from animals killed at that time of the year are thin and unsuitable for the best class of work. Owing to the prejudice against killing cattle, most of the hides are from animals which have died of old age or disease, whereas skins are from goats and sheep slaughtered for food, and Indian skins therefore occupy a better relative position in the world's markets than Indian hides. It is only in a few large towns or military cantonments that hides from slaughtered animals are available in any quantity. Normally the tanned hides and skins are exported chiefly to the United Kingdom, because most other countries offering a market for Indian hides and skins have arranged their tariffs so as to encourage the importation rather of the raw than of the tanned product.

Effects of the War.—The Madras trade both in tanned hides and in tanned skins has been considerably affected by the war, but the changes have not operated in the same way in the two cases. The *Review of the Sea-Borne Trade of the Madras Presidency* for 1915–16 states that after the loss of enemy markets the Madras tanners bought large quantities of the stocks of raw hides which accumulated in Calcutta, Agra, Cawnpore, and other

northern hide-producing centres. These hides were tanned in Madras ; shippers bought them freely, and sent heavy consignments to the United Kingdom. It was only to the United Kingdom, Ceylon, and the Straits Settlements that the export of tanned hides was allowed. For a time the supplies despatched to the United Kingdom were equal to the demand, and prices lagged after an initial rise ; but subsequent to 1915–16, with the continued growth of military requirements and the adaptation of the leather-dressing industry in this country to war conditions, not only did the exports from Madras continue to expand, but prices again advanced, up to 50 per cent. on average above pre-war figures. As regards the exports of tanned goat-skins, trade with the United States increased over four-fold in 1915–16 and 1916–17, compared with 1913–14, but trade with the United Kingdom declined. Formerly German buyers purchased the bulk of the skins sold in the London market for their trade in finished leather goods. After war broke out many difficulties stood in the way of any determined efforts by British manufacturers to capture the trade. The opportunity was seized by American firms, who made arrangements for shipments direct to the United States instead of via London. In December 1916, however, the exportation of tanned skins from India was prohibited to all destinations except the United Kingdom, while by a Notice issued in Madras and Bombay in May 1917, as already stated, it was forbidden to put goat or sheep skins into tannage except by express permission. Later in the year licences were granted to renew the trade with the United States to a limited extent ; the American Consul in Madras reported on October 4th, 1917, that the first consignment of tanned skins to the United States since the prohibition came into force was expected to be forwarded shortly (*Commerce Reports*, 1917, 285). But, with the restrictions imposed on the tanning of skins, supplies were naturally much reduced, and the trade returns for 1917–18 already quoted show how marked was the decline in the exports.

Much attention is being given by the Government of India, as well as by private firms, to the improvement and extension of the tanning industry in India. As

announced by H. E. the Viceroy in his address at the opening meeting of the Imperial Legislative Council's autumn session at Simla in September 1917, tanners in India have been given orders on a scale which has encouraged them to reform their methods, and by having to work regularly to a rigid standard of high quality a striking improvement in their work has already taken place. The Munitions Board, with the generous consent of a group of Central Indian States, has taken over the tannery at Maihar to test new tan stuffs, new combinations of known materials, new processes, and the manufacture of concentrated tanning extracts. The results are being tested on a commercial scale at the Allahabad tannery, which has been purchased for the purpose. In co-operation with the Forest Department the Munitions Board has organised the collection of promising materials, and has arranged with the railway companies for their distribution at uniform and low rates of freight. Students are being taken as apprentices, and it is hoped to form at Allahabad an institute in which the scientific aspects of tanning will be taught in conjunction with practical work on a commercial scale.

An important factor in the reputation acquired by Madras in connection with the tanning industry is that Avaram or Tarwad bark (*Cassia auriculata*) is found chiefly in the Madras and Bombay Presidencies, also in Mysore and Hyderabad States. This is one of the most useful materials for the production of soft leather by unskilled labour, but it is comparatively expensive. According to a *communiqué* issued by the Madras Government in April, 1918, the tanneries in North India, which have an advantage over the Madras tanneries in respect of the supplies of raw hides, have been trying to discover a tanning mixture equal to Avaram bark, and though they have not achieved complete success they have gone a long way towards it, and have produced some very cheap mixtures. To compete with these the price of Avaram bark must be greatly reduced. At present supplies are obtained by collecting the wild product, and are limited, but it is believed that they might be greatly increased, with consequent reduction in price,

if the shrub were cultivated. Land grants for this purpose are being offered to cultivators by the Madras Government on favourable terms.

Cow-hides (Kips)

From an economic standpoint, cattle in India play much the same part as draught-horses in England. Bulls and bullocks are the ordinary beasts of burden. They do the work on the farms—ploughing and other agricultural operations. They are the commonest means of transport: loads are hauled in bullock-wagons in the country districts and through the streets of cities; travellers are conveyed in bullock-carts where no railways run. Cows are of some economic value as milk-producers. But cattle breeding and rearing for meat supply are almost unknown in India. The religious scruples of the Hindus against taking life, and the special sanctity attaching in their eyes to the cow, combine to ensure a natural death to the vast majority of the cattle in India. It follows that there are large numbers of old and worn animals, which fall a specially easy prey to outbreaks of virulent diseases and to the scarcity of famine years. At such times the rate of mortality among cattle is greatly increased, and the exports of hides go up with a bound.

These conditions affect not only the quantity but the quality of the hides exported. Beasts that have dragged out a lingering existence will not supply hides of the same quality as slaughtered prime cattle. Apart, however, from this fundamental characteristic of the trade in Indian hides, the cattle of India are, in general, not of a high grade. There are various breeds both of heavy draught cattle and of cattle for quick road work, as well as certain good milking strains, which are maintained by the observance of sound principles of cattle-breeding. But as regards the great mass of the cattle no attention is paid to such matters. Good grazing lands are limited. Stock farming is not general. The possession of cattle is a circumstance attendant on the pursuit of agriculture. Breeding is little regulated, and the animals are badly fed. In the rice tracts the diet consists largely of rice straw, and the cattle are often miserably weak. But

perhaps the chief distinguishing feature of Indian cow-hides is their small size and weight. Indian cattle are very much smaller than English, the average weight of the raw hides being only 9 lb. in a dried state, equivalent to 24 lb. wet. The various breeds, however, differ considerably in size. Judged by the hides which enter into the export trade, the smallest cattle are found in the north-east (where Dacca is the centre for the collection of hides), south-east and south-west districts; the largest in Sind, Rajputana, and the Punjab; and intermediate sizes in the Central Provinces. Size is not a criterion of value from the leather merchant's point of view, for some of the largest hides are the worst in quality, coming from badly fed animals which yield a flat skin with a humpy shoulder. In comparisons of weights, account must also be taken of the method of curing the raw hides. A great change has taken place in this respect during the past half-century. Formerly practically all the hides were cured by the use of lime, salt, and earth, and the creation of false weight was a native science. Now the great bulk of the hides exported are dried out in the sun or under cover, and treated with an arsenical solution. Arsenicated and dry-salted hides may range in weight from a maximum of 24 lb., for bulls, down to $\frac{3}{4}$ lb. for calf-skins; wet-salted hides may weigh as much as 36 lb. Practically all, however, are unsuitable for the manufacture of sole leather, and their chief use is for making upper shoe leather. In the early stages of the war the raw hides considered by the War Office to have military value were arsenicated hides weighing 6 lb. or over, and dry-salted hides weighing 9 lb. or over. In March 1917, however, all hides weighing over 4 lb. arsenicated, 7 lb. dry-salted, and 12 lb. wet-salted, including rejections and double rejections, were reserved by the Government of India for export on Government account.

Defects of Preparation.—Dry-salting is still extensively practised in the case of hides exported from Dacca, and wet-salting in the case of some of the hides exported from Burma. In both cases the hides have an unfavourable reputation in Europe, owing not so much to the use as to the abuse of the methods employed. Hides

lightly salted after being thoroughly fleshed are excellent for tanning. Those exported from Dacca, however, are not only heavily weighted with salt earth, but are often disfigured by butcher-cuts made during flaying, and have adhering to them a large amount of flesh, which sets up putrefaction. Intrinsically Dacca kips constitute a good class of hides, being generally of good pattern and fairly well grown; but they are largely spoiled in their treatment, which in the opinion of one leading firm of importers is worse to-day than it was fifty years ago. The hides exported from Burma vary greatly both in growth and quality. Rangoon is the outlet for hides not only from all over Burma, but from the trans-frontier districts of China and Annam, though as regards the supplies from across the Chinese frontier a competing route which is beginning to make its influence felt is that afforded by the French railway connecting Yunnan-fu with Haiphong (Tongking). Some of the hides exported from Rangoon are intrinsically very fine, and the trade, which has already grown considerably in the last few decades, is capable of much further expansion. Yet the condition in which the hides are exported has led to the assertion that no hide-producing country under British control is so far behind the times as Burma. The southern supply consists of sun-dried and arsenicated hides, but in the northern coastal districts in particular the hides are heavily cured and adulterated and very badly flayed, and in Rangoon itself the practice has grown up of wet-salting hides which have already been dried.

Most of these criticisms do not apply to the main supplies of raw Indian cow-hides. Those from the north-west parts of India are for the most part well prepared and flayed. In general, however, the flaying of hides in India is not of a high standard. The flaying of city-slaughtered cattle is done by Mohammedans, who also do the slaughtering. Cattle which die a natural death are usually flayed by low-caste Hindus. A suggestion that the quality of the work might be improved by a system of bonuses for well-flayed hides finds strong support in the results of a recent experiment in Bombay. About 200 cattle are killed daily in the Bandra slaughter-house, which is

under the Bombay municipality. Formerly only about a third of the hides could be used for Army purposes: the rest had to be rejected because of butcher-cuts. The Market Superintendent granted the workmen an extension of time for slaughtering, and the buyer for the Government Tannery was authorised to pay the skinners a bonus of two annas for every well-flayed hide. As a result, according to a Government *communiqué* dated October 1st, 1917, less than 5 per cent. of the hides have since been rejected for faulty flaying.

Unfortunately, this gain in efficiency has not been general. In May, 1918, the Indian Munitions Board issued a statement to the Calcutta dealers in raw hides, regretting that no improvement had been effected in the cure and fleshing of dry-salted hides, and giving notice that on and after July 15th, 1918, Government would refuse to purchase any raw hides which were not cleanly-fleshed or which bore more cure than was necessary for the preservation of the hide. The style of cure laid down as a standard is that of the original cure of "real Meherpore" hides.

Another defect in the hides which greatly limits their value for tanning purposes is due to the native methods of branding cattle. Sometimes the brand consists of double semi-circular lines covering the butt part of the hide and even extending to the shoulder. It has been estimated that as a result of this practice there is a reduction of between one and three rupees in the value of each hide. In some districts nearly half the hides are spoiled for Army purposes by branding. The Indian Munitions Board has brought the matter to the attention of Local Governments in the hope that native owners of cattle may be induced to adopt the use of smaller brands.

The religious customs of the natives play their part in the branding of cattle, as in other matters affecting the trade in Indian hides. Veterinary methods are also an important factor. Suggestions for obviating the difficulty are now under consideration. If they can be carried out, and if at the same time means can be devised for securing better workmanship in the flaying and curing of the hides, the reputation of East Indian kips will be

greatly benefited, with corresponding advantage to the prices they command.

Exports of Raw Kips.—The following table shows the number, the total weight and value, and the average weight and value, of the raw cow-hides exported from India in each year for which returns are available. The year 1912–13 was the first in which these exports were separately recorded in the Indian trade returns :

Exports of Raw Cow-hides from India

Year.	Quantity.		Value.	Average weight.	Average export value per lb.
	Number.	Weight. Cwts.	£	lb.	d.
1912–13 . .	10,277,990	831,200	3,969,754	9·1	10·2
1913–14 . .	8,967,518	743,037	3,937,007	9·3	11·4
1914–15 . .	5,947,080	480,513	2,477,553	9·0	11·0
1915–16 . .	8,180,599	689,113	3,743,928	9·4	11·6
1916–17 . .	6,410,937	581,645	3,335,926	10·2	12·3
1917–18 . .	—	317,588	1,546,798	—	10·4

During the war, up to and including the year 1917–18, the exports of raw cow-hides fell off considerably in quantity, and prices did not greatly increase ; in 1917–18, indeed, the average export value per lb. was less than in the year before the war. In percentages of the exports in 1913–14, the exports in the four following years were : in 1914–15, weight 65, value 63 ; in 1915–16, weight 93, value 95 ; in 1916–17, weight 78, value 85 ; in 1917–18, weight 43, value 39.

The following table shows the dominant position occupied by the ports of Bengal in the export trade in raw cow-hides, and also the growing importance of the Sind ports (Karachi) during the first three years of war :

Exports of Raw Cow-hides by Provinces

Provinces.	Percentages of weight.				
	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Bengal . .	77·8	76·0	72·9	73·2	56·5
Sind . . .	10·5	9·5	12·2	16·8	22·6
Burma . .	9·9	12·6	12·5	10·0	11·7
Others [1] . .	1·8	1·9	2·4	—	9·2
Total . .	100·0	100·0	100·0	100·0	100·0

[1] *Almost wholly Bombay.*

The distribution of the raw cow-hides exported, as given in the Indian trade returns, is shown in the following table. The italicised figures denote percentages.

Exports of Raw Cow-hides: Distribution

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	831,200	743,037	480,513	689,113	581,645
,, value	£3,969,754	3,937,007	2,477,553	3,743,928	3,335,926

	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
To British Countries:					
United Kingdom	35,076 *4·2*	14,919 *2·0*	77,923 *16·2*	56,298 *8·2*	106,099 *18·2*
Canada	5,247	8,978	2,261	11,006	12,848
Others	757	166	156	4,581	2,300
Total	41,080 *4·9*	24,063 *3·2*	80,340 *16·7*	71,885 *10·4*	121,247 *20·9*
To Allied Countries:					
Italy	116,095 *14·0*	92,662 *12·5*	66,211 *13·8*	358,718 *52·1*	163,721 *28·1*
France	17,844 *2·1*	14,283 *1·9*	6,867 *1·4*	21,679 *3·1*	37,308 *6·4*
Belgium	18,850 *2·3*	20,435 *2·8*	6,565 *1·4*	—	—
United States	69,434 *8·4*	36,820 *5·0*	73,884 *15·4*	191,657 *27·8*	208,604 *35·9*
Others	2,397	2,127	736	9	2,310
Total	224,620 *27·0*	166,327 *22·4*	154,263 *32·1*	572,063 *83·0*	411,943 *70·8*
To Enemy Countries:					
Germany	365,874 *44·0*	356,195 *47·9*	137,655 *28·6*	—	—
Austria-Hungary	113,620 *13·7*	141,537 *19·0*	38,865 *8·1*	—	—
Turkey	8,924	2,961	572	—	—
Bulgaria	2,683	1,422	1,995	—	—
Total	491,101 *59·1*	502,115 *67·6*	179,087 *37·3*	—	—
To Neutral Countries:					
Spain	57,793 *7·0*	41,865 *5·6*	41,890 *8·7*	28,135 *4·1*	34,341 *5·9*
Holland	16,252	7,771	2,046	—	—
Norway	125	83	2,243	9,862	13,531
Sweden	—	—	19,526	6,564	—
Others	229	813	1,118	604	583
Total	74,399 *9·0*	50,532 *6·8*	66,823 *13·9*	45,165 *6·6*	48,455 *8·3*

In the year before the war over two-thirds of the exports of raw cow-hides from India were consigned to enemy countries (Germany, nearly half), and between one-fifth and one-fourth to Allied countries. Exports to the United Kingdom were only 2 per cent. of the total and to all British countries only 3·2 per cent. During

the war the United States and Italy have taken the bulk of the exports. According to a statement issued by the Government of India and published in the *Indian Trade Journal* (1917, **44**, 206), in the pre-war cow-hide trade from Calcutta the hides taken by Germany and Austria averaged about 9½ lb. in weight; it is believed that the heaviest were used exclusively for the Scandinavian market. The hides taken by Italy and Spain averaged from 5½ lb. to 6 lb. The war made no change in this respect in the Spanish trade, but Italy's takings, which in 1915–16 especially were very greatly increased, went up in average weight to 7½ lb. Heavier classes of hides have been taken by the United States (11½ lb.) and the United Kingdom (12 lb.).

In Europe the chief centre of the pre-war trade in raw Indian cow-hides was Hamburg, and in India the collection and export of the hides had passed into the hands of firms consisting of Germans, or naturalised persons of German origin, who formed an effective ring. One or two English firms had attempted occasionally to enter the trade, but failed to break the ring, and in the case of an Indian firm which made the attempt the ring adopted, with some success, a policy of boycott. During the war steps have been taken not only to cut off supplies from enemy markets, but to bring the trade at its source under British control. Proposals for dealing with the post-war trade problem were made by the Imperial Institute Committee on Hides and Tanning Materials, after consultation with the United Tanners' Federation of Great Britain and Ireland, and with representatives of British firms in India, who were ready to enter the trade under certain conditions. Lecturing before the Indian Section of the Royal Society of Arts on the Indian Hide and Leather Trade on February 14th, 1918, Sir Henry Ledgard, a member of the Committee and lately President of the Upper India Chamber of Commerce, stated (*Journal R.S.A.*, 1918, **48**, 281) that the Tanners' Federation were prepared to handle increasing quantities of kips up to 4,000,000 in the third year after the conclusion of the war, subject to:

1. The imposition in India of an export duty on raw

hides, to be remitted in the case of hides tanned within the Empire.

2. The elimination of firms with German or Austrian connections from the trade.

3. The granting, where necessary and advisable, of financial assistance to tanners adapting their yards or building tanneries to deal with East Indian hides.

Sir Henry Ledgard added that in their report the Committee of the Imperial Institute "also laid stress on the importance of the fullest development possible of the tanning of kips in India which shall involve the employment of Indian labour and capital in the manufacture of leather goods from Indian tanned leather."

Recent developments in the tanning of kips in India will be seen from the next section.

Tanned Cow-hides.—The exports of tanned cow-hides from India in each year for which returns are available are shown in the following table:

Exports of Tanned Cow-hides from India

Year.	Quantity.		Value.	Average weight.	Average export value per lb.
	Number.	Weight. Cwts.	£	lb.	d.
1912–13 .	2,936,440	215,429	1,278,000	8·2	12·7
1913–14 .	2,096,857	158,383	982,654	8·8	13·3
1914–15 .	2,480,225	191,565	1,447,126	8·7	16·2
1915–16 .	3,273,820	247,380	1,892,594	8·5	16·4
1916–17 [1] .	3,867,418	286,210	2,687,622	8·3	20·1
1917–18 [2] .	—	342,806	3,115,887	—	19·5

[1] *Including* 140,869 *cwts. valued at* £1,274,432 *on Government account (average value per lb.,* 19·4*d.).*

[2] *All but* 909 *cwts., valued at* £9,567, *on Government account.*

The average weight of the tanned hides exported is slightly (under 1 lb.) less than that of the raw hides. Before the war the difference between the average prices (export value) of the raw and tanned hides was from 2*d.* to 2½*d.* per lb.; in the first two years of the war it rose to 5*d.* per lb., in 1916–17 to nearly 8*d.* per lb., and in 1917–18 to 9*d.* per lb., this being due to the increase in value of the tanned hides. The total quantity exported has also increased. In percentages of the exports in 1913–14, the exports in the four following years were: in 1914–15, weight 121, value 147; in 1915–16, weight 156, value 193; in 1916–17, weight 181, value 274; in 1917–18, weight 216, value 317. Coincident with this

increase in the exports of tanned cow-hides there was, as already noted, a large decrease in the exports of raw cow-hides. Consequently during the war the proportion of tanned to raw hides has greatly increased. In 1912–13 the proportion by weight was a little over 1 to 4, and in 1913–14 a little over 1 to 5, whereas in 1916–17 it was nearly 1 to 2, and in 1917–18 the weight of tanned hides exported was actually a little in excess of the weight of raw hides.

About 80 per cent. of the exports of tanned cow-hides from India are despatched ordinarily from Madras ports (nearly all from the port of Madras), and the rest almost wholly from Bombay ports. The Madras *Handbook of Commercial Information* states that tanned (unfinished) cow-hides are exported from that presidency in pressed, gunnied, roped bales, each containing from 650 lb. to 675 lb., or sometimes 700 lb. These tanned hides are available for export all the year round, and are sold on standards, of which each firm has its own. They are mostly described by names of localities: *i.e.* Coasts, Bangalores (Best and Ordinary), Pallavarams, Hyderabads, Cocanada Coasts. Light Cocanada Coasts weigh about 7½ lb. and light Bangalores 8 lb. to 8½ lb. (minimum in both classes, 3 lb.; maximum, 14 lb.). "Heavies" in both classes usually weigh from 14½ lb. to 16 lb. (minimum, 12 lb.; maximum, 20 lb.). All but one or two per cent. of the total exports of tanned cow-hides from India are consigned ordinarily to the United Kingdom, and it is believed that they are mostly absorbed into the industry of this country. The precise figures given in the Indian trade returns are:

Tanned Kips: Distribution of Exports from India

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	215,429	158,383	191,565	247,380	286,210
„ value £	1,278,000	982,654	1,447,126	1,892,594	2,687,622
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
To British Countries:					
United Kingdom	213,673 / 99·2	155,550 / 98·2	189,551 / 98·9	246,366 / 99·6	285,330 / 99·7
Others . .	1,179	799	572	1,014	863
Total . .	214,852	156,349	190,123	247,380	286,193
To Foreign Countries	577	2,034	1,442	—	17

One reason why foreign countries take so small a proportion of the tanned kips is that most countries, *while admitting raw hides free, impose a tariff on tanned* hides. So long as that condition continues, and subject to whatever limit there may be to the ability of British industry to absorb the tanned kips, it would seem that, apart from any other action which might be taken, the British share in the total trade in Indian cow-hides might be increased by extending the tanning of these hides in India before export.

Although the United Kingdom has always been the chief market for Indian tanned cow-hides, leather of this description was so little appreciated for the uppers of British Army boots before the war that War Office contracts ruled out East India kips in favour of heavy ox-hides (Sir Henry Ledgard, *opus cit.*). During the war there has been a great change. The *Pioneer Mail* of January 25th, 1918, quoting the Controller of Hides and Wool in India, stated that at least three-fifths of the upper leather used in the United Kingdom in the manufacture of boots for the Allied Armies was supplied from East India kips. The magnitude of the demand may be appreciated from the further statement that the minimum requirements of Army upper leather for the year 1917 were estimated at 80,000,000 feet. Nor are the export returns the only measure of the increased output of tanned kips in India. There has been a great development in the Indian manufacture of leather accoutrements and boots to meet the needs of the Army in India and the Indian Expeditionary Forces. In this connection, according to the *Pioneer Mail*, the Indian Munitions Board arranged to supply 35,000 kips monthly to the boot factories in Cawnpore, and 8,000 kips monthly to the Government Harness and Saddlery Factory in Cawnpore.

Buffalo-hides

Buffaloes are used in India for the same purposes as other cattle—the bulls for tillage and road work, the cows for the supply of milk. They are not so numerous as ordinary cattle, but are larger and more powerful. There are considerable differences between the different

breeds, and generalised statements can only be made with reserve; but the buffaloes of southern India are mostly smaller and less valuable than those found in the northern provinces and Burma. Little attention is given to breeding. As a rule, bull buffaloes can be bought very cheaply, and except in specially good grazing districts it does not pay to make a business of rearing them. Both bulls and cows are slaughtered in large numbers, notably at Agra, Aligarh, and Sekundra, for the dried meat export trade to Burma. In 1915–16 Burma's imports of this commodity from other provinces were valued at £150,000.

Raw Buffalo-hides.—The Indian export trade in buffalo-hides, raw and tanned, amounts in weight to about one-third of the export trade in cow-hides. Separate returns were first published in 1912–13. The following table shows the number, total weight and value, and average weight and value of the raw buffalo-hides exported in that and subsequent years:

Exports of Raw Buffalo-hides

Year.	Quantity.		Value.	Average weight.	Average value per lb.
	Number.	Weight. Cwts.	£	lb.	d.
1912–13	2,055,678	345,037	1,266,071	18·8	7·9
1913–14	1,967,018	345,864	1,469,113	19·7	9·1
1914–15	1,213,113	211,745	921,993	19·5	9·3
1915–16	970,742	162,887	621,837	18·8	8·2
1916–17	1,495,046	261,099	1,351,626	19·6	11·1
1917–18	—	84,900	425,112	—	10·7

The average weight of the raw buffalo-hides exported is about double that of the raw cow-hides. The average export value of buffalo-hides before the war was about 2*d.* per lb. less than that of cow-hides, and in 1915–16 the difference increased to nearly 3½*d.* per lb.; but in 1917–18 buffalo-hides commanded a slightly higher price than cow-hides. During the war there has been a marked decrease in the exports of raw buffalo-hides, and in 1917–18 the drop was especially great. In percentages of the exports in 1913–14 the exports in the next four years were: in 1914–15, weight 61, value 63; in 1915–16, weight 47, value 42; in 1916–17, weight 75, value 92; in 1917–18, weight 25, value 29.

Bengal is the outlet for about four-fifths of the exports of raw buffalo-hides; Burma provides from 10 to 15 per

cent. (only 5 per cent. in 1916–17); and most of the remainder are despatched from Sind. The hides from Bengal were mostly exported, before the war, to Austria and the United States, the average weights taken by those two countries being about the general mean—19 to 20 lb. The hides from Burma are much heavier. They used to be exported chiefly to the United Kingdom and Turkey, which took weights of from 40 to 60 lb. (*Indian Trade Journal*, 1917, **44**, 206). The distribution of the total exports, before and during the war, is shown in the following table, the italicised figures denoting percentages:

Raw Buffalo-hides: Distribution of Exports

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	345,037	345,864	211,745	162,887	261,099
„ value	£1,266,071	1,469,113	921,993	621,837	1,351,626
To British Countries:	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom .	46,551 *13·5*	26,254 *7·6*	52,062 *24·6*	41,711 *25·6*	37,426 *14·3*
Others. . .	4,576	5,639	957	1,109	2,152
Total . .	51,127 *14·8*	31,893 *9·2*	53,019 *25·0*	42,820 *26·3*	39,578 *15·2*
To Allied Countries:					
United States .	143,766 *41·7*	114,476 *33·1*	107,074 *50·6*	108,495 *66·6*	215,718 *82·6*
Italy . . .	10,921 *3·2*	7,150 *2·1*	1,322 *0·6*	10,251 *6·3*	2,233 *0·9*
France . .	6,646 *1·9*	3,232 *0·9*	1,368 *0·6*	55	230
Others . .	3,612	1,928	788	14	1,783
Total . .	164,945 *47·8*	126,786 *36·7*	110,552 *52·2*	118,815 *72·9*	219,964 *84·2*
To Enemy Countries:					
Austria-Hungary	58,276 *16·9*	91,736 *26·5*	20,799 *9·8*	—	—
Germany . .	22,148 *6·4*	30,785 *8·9*	7,744 *3·7*	—	—
Turkey . .	15,685 *4·5*	30,134 *8·7*	10,277 *4·9*	—	—
Bulgaria . .	2,966	1,241	2,684	—	—
German East Africa	4	—	—	—	—
Total . .	99,079 *28·7*	153,896 *44·5*	41,504 *19·6*	—	—
To Neutral Countries:					
Holland . .	25,966 *7·5*	32,485 *9·4*	3,097 *1·5*	—	—
Others . .	3,920	804	3,573	1,252	1,557
Total . .	29,886 *8·7*	33,289 *9·6*	6,670 *3·2*	1,252 *0·8*	1,557 *0·6*

As in the case of raw cow-hides, only a minor part of the exports of raw buffalo-hides from India before the war was consigned to countries within the British Empire, though in 1912–13 the United Kingdom stood third in the list among individual countries. Foreign countries took 85 per cent. of the total in 1912–13, and over 90 per cent. in 1913–14. But whereas the largest buyer of kips was Germany, the largest buyer of buffalo-hides was the United States, which took two-fifths of the total in 1912–13 and a third of the total in 1913–14. The next largest share of the pre-war exports was taken by Austria-Hungary—one-sixth in 1912–13, and one-fourth in 1913–14. It is interesting to compare the exports to all Allied countries and all Enemy countries in the two years before the war. The total exports in those two years were practically the same. In 1912–13 Allied countries took 47·8 per cent. of the total, against 28·7 per cent. consigned to Enemy countries. In 1913–14 the positions were reversed, Enemy countries taking 44·5 per cent. of the total against 36·7 per cent. consigned to Allied countries. In the first two years of the war the United States strengthened the dominating position it occupied in this trade, taking half the total exports of raw buffalo-hides in 1914–15 and two-thirds of the total in 1915–16; but this increase in the United States percentage share of the trade was entirely due to the shrinkage of the total exports, for neither in 1914–15 nor in 1915–16 were the actual exports to the United States so large as either in 1912–13 or in 1913–14. In 1916–17, however, not only did the proportion of the exports consigned to the United States increase to over four-fifths, but the quantity was 50 per cent. greater than in 1912–13, the previous highest on record. The United Kingdom's share in the trade increased during the first two years of the war to one-fourth of the total, but declined again in 1916–17 to 14·3 per cent.; the actual exports to the United Kingdom, during the quinquennium for which returns are available, reached their minimum in 1913–14 (26,000 cwts.) and their maximum in 1914–15 (52,000 cwts.).

Tanned Buffalo-hides.—Very few buffalo-hides, comparatively, were tanned for export before the war, but the

character of the trade in buffalo-hides has undergone a marked change in this respect during the war. The number, total weight and value, and average weight and value of the tanned hides exported are shown in the following table for 1912–13 (the first year for which separate returns are available) and subsequent years.

Exports of Tanned Buffalo-hides

Year.	Quantity.		Value.	Average weight.	Average value per lb.
	Number.	Weight. *Cwts.*	£	*lb.*	*d.*
1912–13 . .	168,119	17,004	78,612	11·3	9·9
1913–14 . .	160,604	15,545	75,127	10·8	10·4
1914–15 . .	263,040	25,261	157,520	10·8	13·4
1915–16 . .	270,137	24,234	145,102	10·0	12·8
1916–17 . .	339,038	32,178	239,483	10·6	15·9
1917–18 .	—	18,552	126,733	—	14·6

The average weight of the tanned buffalo-hides exported is not much more than half that of the raw hides. Before the war the average value of the tanned hides was only from 1*d.* to 2*d.* per lb. more than that of the raw, but the difference increased during the war till in 1916–17 it was nearly 5*d.* per lb., although in the interval the raw hides had themselves increased considerably in value. In 1917–18 the average export values per lb. of both raw and tanned buffalo-hides declined, and the difference between them was reduced to just under 4*d.* per lb. The total weight as well as the value of the tanned buffalo-hides entering into the export trade increased during the first three years of the war, but dropped again to little more than the pre-war figure in 1917–18. In percentages of the exports in 1913–14, the exports in succeeding years were: in 1914–15, weight 163, value 210; in 1915–16, weight 156, value 193; in 1916–17, weight 207, value 319; in 1917–18, weight 119, value 169. As this increase in the weight of the tanned hides exported was accompanied by a decrease in the export of raw hides, the ratio of raw and tanned hides underwent a striking change during these years. Before the war the trade in tanned buffalo-hides was remarkable for the smallness of its proportion to the trade in raw hides; the proportion of raw to tanned was 20 : 1 in 1912–13 and 22 : 1 in 1913–14. The change on

the outbreak of war was immediate. In 1914–15 the proportion was 8 : 1 ; in the next two years there was little further change ; in 1917–18 the proportion was 4·5 : 1.

Nine-tenths of the Indian export trade in tanned buffalo-hides is done from Madras (86 per cent. in 1912–13, 90 per cent. in 1913–14, 88 per cent. in 1914–15, 97 per cent. in 1915–16, 94 per cent. in 1916–17). The remaining exports of this class practically all find an outlet through Bombay. The Madras *Handbook of Commercial Information* states that the tanned hides are available all the year round, and are packed in pressed bales, wrapped in gunnies and roped, each containing from 650 lb. to 675 lb. Cold-weather hides are slightly better than hot-weather. They are usually sold on standards, and the average weight is given as 12–13½ lb.

The distribution of the exports, as shown by the Indian trade returns, was almost entirely to British countries, even before the war. The following are the figures, with percentages added in italics :

Tanned Buffalo-hides : Distribution of Exports

		1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity	*cwts.*	17,004	15,545	25,261	24,234	32,178
„ value	£	78,612	75,127	157,520	145,102	239,483
To British Countries :		*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom		14,704 *86·5*	14,047 *90·4*	24,371 *96·5*	23,894 *98·6*	31,789 *98·8*
Egypt		1,655 *9·7*	710 *4·6*	161	340	387
Others		179	127	50	—	—
Total		16,538 *97·3*	14,884 *95·7*	24,582 *97·3*	24,234 *100·0*	32,176 *100·0*
To Foreign Countries [1]		466	661	679	—	2

[1] *Mostly to Turkey.*

As in the case of kips, a question for consideration is whether the British share in the total trade in buffalo-hides could not be increased by extending the tanning of these hides in India before export. It is believed that a far larger quantity of buffalo-hides could be absorbed by British industry than is at present the case. The partially tanned hides hitherto taken by the United Kingdom are admirably adapted for dressing, and might command a larger sale, especially if the medium and

heavy hides could be tanned with materials which would produce a more solid leather. Medium weights could be used for in-soling and other purposes for which shoulders are employed, and heavy weights for soles. "Heavies," if chrome tanned, might also be used for picking bands, or in the raw state for pickers. Light weights are suitable for use as upper leather.

CALF-SKINS

Calf-skins form the smallest class of hides and skins separately recorded in the returns of the export trade of India. It is only for raw calf-skins that separate figures are given, and as these are recorded as one of the groups under the heading "Raw Hides," it is to be inferred that tanned calf-skins are included among "Other Hides" under the heading "Hides, Tanned or Dressed." In that case the exports of tanned calf-skins are very small, for the total of "Other Hides, Tanned or Dressed," in the four years 1912–13 to 1915–16 ranged only from 100 cwts. to 830 cwts., and though the total rose to 4,002 cwts. in 1916–17, it was down again to 316 cwts. in 1917–18. The exports of raw calf-skins were first recorded separately in 1912–13, and the figures for that and following years are shown in the following table, with the calculated average weights and values:

Exports of Raw Calf-skins

Year.	Quantity.		Value.	Average weight.	Average value. per lb.
	Number.	Weights. Cwts.	£	lb.	d.
1912–13	1,099,200	29,640	126,652	3·0	9·2
1913–14	809,550	26,116	122,039	3·6	10·0
1914–15	589,433	21,158	99,161	4·0	10·0
1915–16	858,639	29,761	157,367	3·9	11·3
1916–17	1,490,141	50,933	306,401	3·8	12·9
1917–18	—	15,415	85,182	—	11·8

Judged by pre-war standards, the most noticeable features of the subsequent trade in raw calf-skins have been the big increase in the exports in 1916–17 and the big decline in 1917–18. Before the war from 80 to 90 per cent. of the exports were despatched from Bengal ports, the remainder going through Sind. In the first three years of the war the share of Bengal declined to 39 per cent., while that of Sind increased to 60 per cent.

The distribution of the exports is shown in the following table, the italicised figures denoting percentages:

Raw Calf-skins: Distribution of Exports

		1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity	*cwts.*	29,640	26,116	21,158	29,761	50,933
,, value	£	126,652	122,039	99,161	157,367	306,401
		Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
To British Countries[1]		1,483	956	2,044	1,196	1,282
		5·0	*3·7*	*9·7*	*4·0*	*2·5*
To Allied Countries:						
United States		14,921	4,076	8,092	12,813	36,845
		50·3	*15·6*	*38·2*	*43·1*	*72·3*
Italy		5,890	6,822	4,666	14,391	6,917
		19·9	*26·1*	*22·5*	*48·4*	*13·6*
Others[2]		720	342	384	190	24
Total		21,531	11,240	13,142	27,394	43,786
		72·6	*43·0*	*62·1*	*92·1*	*86·0*
To Enemy Countries:						
Germany		404	1,213	1,083	—	—
		1·4	*4·6*	*5·1*		
Austria-Hungary		1,516	4,556	479	—	—
		5·1	*17·5*	*2·3*		
Total		1,920	5,769	1,562	—	—
		6·5	*22·1*	*7·4*		
To Neutral Countries:						
Spain		4,292	6,843	4,023	1,171	5,749
		14·5	*26·2*	*19·0*	*3·9*	*11·3*
Others[3]		414	1,308	387	—	116
Total		4,706	8,151	4,410	1,171	5,865
		15·9	*31·2*	*20·8*	*3·9*	*11·5*

[1] *Practically all to the United Kingdom.*
[2] *Chiefly France.* [3] *Chiefly Holland.*

There are very few exports of raw calf-skins from India to British countries except the United Kingdom, and its share in the trade is only small. The great bulk of the exports before the war were taken by four countries—the United States, Italy, Spain, and Austria-Hungary. These four countries took 90 per cent. of the total in 1912–13 and 85 per cent. in 1913–14. In the first three years of the war most of the exports went to the United States and Italy, Spain making a good third except in 1915–16, when Italy's share was unusually large. In general, the United States has been the principal factor in the trade; in three out of the five years under review, it provided the largest market for India's raw calf-skins.

GOAT-SKINS

Goats are found all over India, and range from the large, well-proportioned, long-haired breeds of the Himalayas to the nondescript but hardy varieties in the south of the peninsula. In the economic life of India they are primarily of importance as a source of milk and meat supply; though the Himalayan breeds are also kept for the sake of their hair. In general, breeding is subject to little control, and the varieties are as numerous as they are ill-defined. The female produces two or three kids at a birth, often twice a year. In the fine weather season the professional shepherds wander over Peninsular India with their sheep and goats, letting them graze by day and at night folding them on arable land, which they fertilise with their droppings, a service regarded as sufficiently valuable to command payment from the cultivators.

Both in weight and in value goat-skins are the second most important constituent of the Indian trade in hides and skins, ranking next to kips. Normally they provide, in raw and tanned skins, exports amounting to over 500,000 cwts., with an export value of over £3,000,000. As in the trade in hides, the great bulk of the exports consist of the raw product. The skins from the male animals are characterised by a strong smell, which does not disappear even from some finishes of the leather; but if the males have been castrated their skins are said to be free from this drawback, and to command a higher price in consequence (*Leather World*, 1918, **10**, 419).

Raw Goat-skins.—The following table shows the exports of raw goat-skins for six years:

Exports of Raw Goat-skins from India

Year.	Quantity.		Value.	Average weight.	Average value per lb.
	Number.	Weight.			
		Cwts.	£	*lb.*	*d.*
1912–13 .	21,716,896	520,954	2,278,616	2·7	9·4
1913–14 .	19,690,958	453,356	2,085,132	2·6	9·9
1914–15 .	16,409,829	382,060	1,561,018	2·6	8·8
1915–16 .	19,618,894	399,951	1,836,543	2·3	9·8
1916–17 .	27,866,563	521,808	4,275,888	2·1	17·6
1917–18 .	—	392,034	2,913,719	—	15·9

The first result of the war was to reduce the exports, but in 1916–17 they were again fully normal in quantity, while the average price, which until then had shown little variation from the pre-war figure, increased nearly 80 per cent. In 1917–18 there was again a considerable reduction in the quantity exported, and a slight reduction in the average price, which, however, remained much above the pre-war figure. In percentages of the exports in 1913–14, the exports in the four following years were: in 1914–15, weight 84, value 75; in 1915–16, weight 88, value 88; in 1916–17, weight 115, value 205; in 1917–18, weight 86, value 140.

The average price per lb. (export value) before the war was slightly less than that of raw cow-hides and slightly more than that of raw buffalo-hides. The average weight is about 2½ lb. The average weight of any particular consignment, however, may differ from this considerably, being determined not only by the size of the skins but by the way in which they are cured. The following particulars from the Madras *Handbook of Commercial Information* will serve to indicate the different methods of treating the skins, though in so far as the statements about these methods are comparative, it must be remembered that the trade of Madras in raw goat-skins forms only a small fraction of the whole. In Madras the skins are mostly dry-salted with the hair on, but sometimes they are flint-dried (air-dried; hard) and very occasionally are wet-salted in the hair, or unhaired and then pickled in a solution of alum and salt. Each skin varies from the rest, and they are very difficult to grade. Firms have their own standards for sorting into firsts and seconds, the substance and condition of the skins being the chief factors taken into account. Supplies are available all the year round, though as a rule cold-weather skins are better than hot-weather skins. Pickled skins are exported in casks, the others in pressed bales packed in mats and gunnies, each containing about 756 lb. net.

Neither the Indian nor the United Kingdom trade returns distinguish between the different classes of raw goat-skins exported or imported; but the United States

trade returns distinguish between "dry" and "green or pickled" skins. In 1913–14 the number of dry goat-skins imported into the United States from India was over six times the number of pickled skins imported, and their value was over six times as great; but the weight of the dry skins was only three times that of the pickled skins. That is to say, a pickled skin weighs on average twice as much as a dry skin, but only fetches the same price. The additional weight imparted to the skin by the pickling process does not add to the value of the skin, and must add to the transport charges. Already most of the raw goat-skins are exported in a dry state, and it would seem to be desirable that the dry method of preservation should be adopted still more widely, unless there is a definite demand for pickled skins for special purposes.

The Indian export trade in raw goat-skins is distributed among the provinces more evenly than the trade in raw hides, but the largest share of the skins, as of the hides, falls to Bengal in normal times. During the first three years of war the ports of Bombay and Sind improved their positions, relatively, at the expense of Bengal. The following table shows the chief percentage shares of the provinces of shipment for five years. (From Burma there are occasional exports of raw goat-skins, but only to the extent of a fraction of 1 per cent. of the total.)

Exports of Raw Goat-skins by Provinces

Provinces.	Percentages (weight).				
	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Bengal . . .	45·6	45·3	41·7	40·0	27·7
Bombay . .	29·1	30·2	33·4	31·3	36·1
Sind . . .	15·7	18·5	20·6	22·3	30·5
Madras . . .	9·4	5·9	4·3	6·4	5·7
	99·8	99·9	100·0	100·0	100·0

The distribution of these exports overseas, as given in the Indian trade returns, is shown in the following table:

Exports of Raw Goat-skins: Distribution

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	520,954	453,356	382,060	399,951	521,808
,, value £	2,278,616	2,085,132	1,561,018	1,836,543	4,275,888
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
TO BRITISH COUNTRIES:					
United Kingdom	56,287 / *10·8*	40,259 / *8·9*	39,305 / *10·3*	33,424 / *8·4*	40,559 / *7·8*
Others[1]	6,885	3,044	3,023	4,943	6,903
Total	63,172 / *12·1*	43,303 / *9·6*	42,328 / *11·1*	38,367 / *9·6*	47,462 / *9·1*
TO ALLIED COUNTRIES:					
United States	381,266 / *73·2*	342,452 / *75·5*	300,676 / *78·7*	353,997 / *88·5*	452,151 / *86·7*
France	35,659 / *6·8*	22,717 / *5·0*	8,667 / *2·3*	7,573 / *1·9*	21,893 / *4·2*
Others[2]	5,668	8,953	9,764	14	302
Total	422,593 / *81·1*	374,122 / *82·5*	319,107 / *83·5*	361,584 / *90·4*	474,346 / *90·9*
TO ENEMY COUNTRIES:					
Germany	12,504 / *2·4*	11,118 / *2·5*	7,003 / *1·8*	—	—
Austria-Hungary	1,295	1,262	56	—	—
Total	13,799 / *2·7*	12,380 / *2·7*	7,059 / *1·8*	—	—
TO NEUTRAL COUNTRIES:					
Holland	21,390 / *4·1*	23,551 / *5·2*	13,547 / *3·5*	—	—
Others	—	—	19	—	—
Total	21,390 / *4·1*	23,551 / *5·2*	13,566 / *3·6*	—	—

[1] *Chiefly Australia.*
[2] *Chiefly Belgium, up to and including* 1914–15.

Three-fourths of the exports of raw goat-skins from India before the war were taken by the United States, whose predominant interests in this trade are attributed to American specialisation in the manufacture of glacé kid. Not only is the total production in the United States many times the production in the United Kingdom, but individual American firms turn out glacé kid in quantities far in excess of the output of any British firm. A few years ago this branch of American industry was suffering from over-production, but it enjoyed a revival

of prosperity in the early stages of the war. In 1916–17 the exports of raw goat-skins from India to the United States formed nearly 87 per cent. of the total, and the actual quantity was greater than before the war. India's next best customers used to be the United Kingdom, France, Holland and Germany. For some years before the war these four countries, with the United States, took over 97 per cent. of the total. The proportion taken by Germany, though small, was increasing (from 1·5 per cent. in 1910–11 to 2·5 per cent. in 1913–14), and so was the proportion taken by Holland (from 3·4 per cent. in 1910–11 to 5·2 per cent. in 1913–14). On the other hand the proportion taken by France was only 5 per cent. in 1913–14 against 7·4 per cent. in 1910–11. Among countries not listed separately in the preceding table, Australia took the bulk of the exports to British countries other than that of the United Kingdom. Before the war the trade was declining; exports to Australia dropped from 9,386 cwts. in 1910–11 to 1,964 cwts. in 1913–14; but both in 1914–15 and in 1915–16 there was some recovery. Practically all the exports to Allied countries other than the United States and France went to Belgium, and the rapid increase of trade in this direction before the war is apparent from the table.

Though a long way behind the United States, the United Kingdom took the next largest share of the exports of raw goat-skins from India. There is, however, a large re-export trade in these skins from the United Kingdom. According to the United Kingdom trade returns, only about one-fifth of the undressed goat-skins imported from India were retained before the war; in 1915 the proportion rose to between one-third and one-fourth, but in 1916 it dropped to less than one-eleventh. The figures have already been given in conjunction with other returns of the United Kingdom trade in Indian hides and skins (see p. 195), but it will be convenient to repeat them here.

United Kingdom Imports of Raw Indian Goat-skins

	1912.	1913.	1914.	1915.	1916.
Number imported .	5,499,192	5,933,071	3,648,301	4,988,277	5,926,264
Number retained .	1,217,481	1,149,836	710,055	1,437,680	511,662

With these figures may be contrasted the following, taken from the Indian trade returns:

Number of Raw Goat-skins exported from India to the United Kingdom

1911–12.	1912–13.	1913–14.	1914–15.	1915–16.
1,406,182	2,109,517	1,412,071	1,275,858	1,289,301

Exact comparison of the Indian export returns with the United Kingdom import returns is impossible, not only because of the difference in the trade years for which statistics are given (calendar years in the case of the United Kingdom, and years ending March 31st in the case of India), but because of the time allowance necessary for transport. In general, however, it will be seen that the Indian export returns are intermediate between the United Kingdom gross and net import returns, though much nearer the net than the gross returns. The two periods of five years covered by the tables differ at each end by nine months, less the time allowance for transport. During the one period (1912–16), according to the United Kingdom trade returns, the gross imports of undressed goat-skins from India amounted to nearly 26,000,000 skins, and the net imports to just over 5,000,000 skins; while in the other period (1911–12 to 1915–16), according to the Indian trade returns, the exports of raw goat-skins to the United Kingdom amounted to 7,500,000 skins. The Indian trade returns aim at giving as nearly as possible the exports to countries of final destination; and in the case of the trade in raw goat-skins with the United Kingdom it would appear that the Indian returns have gone a long way in this direction, but that some further reduction is still necessary.

Incidentally it may be calculated from the Indian trade returns, in regard to the exports of raw goat-skins to the United Kingdom, that their percentage of the whole by weight is greater than their percentage by number; in other words, the skins exported to the United Kingdom are heavier than the average. But the outstanding fact, clearly revealed by the United Kingdom returns, is that the British trade in raw Indian goat-skins is largely a merchant trade: the skins are imported not for the use of British industry, but for sale to foreign buyers. The returns do not show the destinations of the

re-exports of Indian skins, considered separately; but *the distribution of the total re-exports of undressed goat-skins from the United Kingdom show that the Indian skins have been going chiefly to the United States.* Normally between one-third and one-half of the gross imports of undressed goat-skins into the United Kingdom come from India (British countries as a whole supply about four-fifths of the total). Of these total imports from all sources about two-thirds (including four-fifths of the Indian skins) are re-exported. During the four years ending 1914 between 75 and 85 per cent. of these re-exports were consigned to the United States; in 1915 the percentage consigned to that country was 96, and in 1916 it was nearly 90. Before the war the next largest share of the re-exports of undressed goat-skins from the United Kingdom was taken by Germany, whose purchases were rapidly increasing—in 1911, 598,245 skins (nearly 8 per cent. of the total); in 1912, 930,291 skins (nearly 11 per cent.); in 1913, 1,121,994 skins (13 per cent.). During the war the largest share of the re-exports of undressed goat-skins from the United Kingdom, next to that of the United States, has been taken by France (in 1916, 847,230 skins, forming nearly 10 per cent. of the total).

While thus re-exporting to the United States more than half the undressed goat-skins shipped to this country, the United Kingdom takes from the United States large quantities of glacé kid, valued in each of the three years 1913–15 at about one and a half millions sterling, and in 1916 at two and a half millions. Thus there exists a state of affairs in which the raw material of a large and valuable industry is brought into this country, and then sent across the Atlantic for manufacture into an article of which large quantities cross the Atlantic in the reverse direction for sale in this country.

Tanned Goat-skins.—Analysis of the returns of the trade in tanned Indian goat-skins shows that that trade also, so far as the United Kingdom is concerned, is largely a merchant trade. During the last six years for which statistics are available, the total exports of tanned goat-skins from India were:

Exports of Tanned Goat-skins from India

Year.	Quantity.		Value.	Average weight.	Average value per lb.
	Number.	Weight. Cwts.	£	lb.	d.
1912–13	6,996,694	61,741	871,905	0·99	30·3
1913–14	8,575,249	74,126	1,073,767	0·97	31·0
1914–15	7,407,944	61,288	882,965	0·93	30·9
1915–16	8,402,764	70,773	986,999	0·94	29·9
1916–17	10,416,825	83,861	1,697,796	0·90	43·4
1917–18	—	15,303	468,734	—	65·6

In percentages of the exports in 1913–14 the exports of tanned goat-skins in the next four years were: in 1914–15, weight 83, value 82; in 1915–16, weight 95, value 92; in 1916–17, weight 113, value 158; in 1917–18, weight 21, value 44. The abnormal decline in the exports in 1917–18 and the great advance in their average value per lb. must both be considered in the light of government restrictions on industry and trade, including, it will be remembered, the prohibition of the tanning of skins in Madras and Bombay except by special permission. Unlike the Indian hides (both cow-hides and buffalo-hides), which gain comparatively little in export value per lb. by tanning, the average export value of tanned goat-skins per lb. is normally more than three times that of the raw skins (about 30*d.* per lb. tanned against 9*d.* to 10*d.* per lb. raw). This is true of each of the first four years in the last table. In 1916–17, when the prices of both raw and tanned goat-skins rose abnormally, the relation of the tanned to the raw skins in respect of average export value was about 5 : 2 (43·4*d.* per lb. against 17·6*d.* per lb.; and in 1917–18, when the average price of tanned skins continued to rise sharply, while that of raw skins declined a little, the proportion was as much as 4 : 1 (65·6*d.* per lb. against 15·9*d.* per lb.). On the other hand the big difference between the average weights of the raw and the tanned skins is noteworthy—the tanned skins averaging just under 1 lb. against about 2½ lb. in the case of the raw skins. The difference would seem to be largely due to the proportion of the raw skins which are exported in the "green" or "pickled" state. Those imported into the United States in this condition have an average weight of between 3 lb. and 4 lb., whereas the "dry" skins imported into the States average only

from 1¼ lb. to 1¾ lb. If the average value per skin and *not the average value per lb.* be taken as the standard of comparison, *the difference between the values of the* raw and the tanned product is not nearly so great. Thus in 1913–14 the average value per skin of the raw goat-skins exported was 25·4*d.* and of the tanned skins 30·1*d.*

From three-fourths to four-fifths of the exports of tanned goat-skins from India are despatched from Madras, and most of the remainder from Bombay, though from 2 to 4 per cent. of the total find an outlet through Sind. The skins for the Madras trade are drawn from Mysore as well as from the Presidency. The port of Madras has a practical monopoly of the trade. The tanned skins, like the raw, are available all the year round. For export they are pressed, wrapped in gunnies, and roped, each bale weighing about 600 lb. net. They are described according to the locality from which they come, *e.g.* Trichies, Coimbatores, Dindiguls, Coasts; also, in some cases, according to the quality, as Prime City and Medium City.

The distribution overseas of the total exports of tanned goat-skins from India, both before and during the war, as given in the Indian trade returns, is shown in the following table (the italicised figures are percentages):

Exports of Tanned Goat-skins from India: Distribution

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	61,741	74,126	61,288	70,773	83,861
„ value . .	£871,905	1,073,767	882,265	986,999	1,697,796
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
To United Kingdom .	56,644	66,446	53,404	44,849	53,027
	91·7	*89·6*	*87·1*	*63·4*	*63·2*
„ United States .	2,641	5,846	6,913	25,682	30,073
	4·3	*7·9*	*11·3*	*36·3*	*35·9*
„ Germany . .	2,369	1,663	670	—	—
	3·8	*2·2*	*1·1*		
„ Other countries .	87	171	301	242	757
	0·2	*0·3*	*0·5*	*0·3*	*0·9*

Before the war the tanned goat-skins exported from India, like the tanned hides, were consigned chiefly to the United Kingdom. Indeed the trade was almost entirely in the hands of United Kingdom buyers. They were taking nine-tenths of the total; and the United States and Germany were the only other countries taking more than trifling quantities. On the outbreak of war

the exports to Germany ceased; at first there was little development in the direct trade with the United States, *and in 1914–15 the United Kingdom still took 87 per* cent. of the total; but *both in 1915–16 and in 1916–17* the exports of tanned goat-skins from India to the United Kingdom declined to 63 per cent. of the total, while those to the United States increased to 36 per cent. The loss to the industry, as distinct from the trade, of the United Kingdom, was not so great as might appear from these figures. On the contrary, the industrial supply of Indian tanned goat-skins in the United Kingdom during the war, up to and including 1916, would seem to have been larger than before the war. The United Kingdom statistics do not show what proportion of the imports of tanned goat-skins from India alone are re-exported, but it may be inferred from the returns of the United Kingdom trade in tanned goat-skins from all overseas sources that ordinarily by far the greater part of the Indian skins imported are sent out of the country again. The following table gives the returns for the five years period beginning 1913—the first year for which such returns were published (the italicised figures are percentages of the total imports):

United Kingdom Trade in Rough Tanned Goat-skins

Imports from	1913. *Cwts.*	1914. *Cwts.*	1915. *Cwts.*	1916. *Cwts.*	1917. *Cwts.*
British India .	62,935 *81*	60,302 *82*	56,501 *84*	78,781 *93*	
British West Africa	12,588	9,959	8,715	5,726	
Other countries .	1,764	2,887	1,998	251	
Total Imports .	77,287	73,148	67,214	84,758	36,588
Re-exports . .	65,342 *85*	57,544 *79*	39,434 *59*	70,344 *83*	27,015 *74*
Net Imports .	11,945	15,604	27,780	14,414	9,573

Contrary to what has been noticed in connection with the trade in raw goat-skins, the exports of tanned goat-skins from India to the United Kingdom, as given in the Indian returns (see p. 230), are in much closer agreement with the gross than with the net imports of tanned goat-skins into the United Kingdom from India, as given in the United Kingdom returns. According to the latter returns, over 80 per cent. of the total imports of such skins before the war came from India, and the proportion

increased to 93 per cent. in 1916. Of these total imports, however, three-fourths or more were re-exported in each of the last five years except 1915, when the proportion fell to three-fifths. The quantity retained in the year before the war was 11,945 cwts., and this was exceeded in each of the next three years; but in 1917, when the total imports were over 50 per cent. below the average for the previous four years, the quantity retained fell to 9,573 cwts. The largest share of the re-exports in 1913 went to Germany (42 per cent.), but the United States (33 per cent.) was not far behind, and during the war most of the re-exports have gone to the latter country (80 per cent. in 1915; 81 per cent. in 1916). The chief uses to which these Indian tanned goat-skins are put are bookbinding and the manufacture of fancy leather articles.

Sheep-skins

Like other tropical breeds, the sheep of Peninsular India are not generally distinguished for either their mutton or their wool. The fleece is often coloured (red or brown or grey) and the wool tends to be short and coarse. The ewe rarely produces more than one lamb at a birth, but may bear young twice a year. Here and there attempts have been made to improve the breed, and the results obtained by crossing Deccani ewes with Dumba rams—the fat-tailed sheep of Afghanistan—are described as very satisfactory, the half-breeds yielding good mutton and long fine wool, like that of the pure Dumba. In some of the cooler parts of India farther north, where the wool-producing qualities of the sheep reach a higher general level, good results have been obtained by the introduction of merinos from Australia, and the half and three-quarter bred rams are in great demand in the Punjab and the United Provinces. So far, however, grading-up experiments have been on a comparatively small scale, and of a tentative character; the great mass of the flocks are still untouched. Apart from breed-improvement measures, it is claimed that much good would result from the more general adoption of the practice of dipping. Some years ago (*Agric. Journ. India*, 1912, **7**, 55), Major F. S. H. Baldrey, Superintendent

of the Civil Veterinary Department in the Central Provinces, estimated that the average weight of the wool clip would be increased from 3 lb. to 4 lb. per sheep, and the value from *6d.* to *7d.* per lb. if the animals were not tormented by skin parasites. Even as things are, the annual exports of raw wool from India before the war amounted to about 50,000,000 lb., with an export value of about £1,750,000 sterling.

Raw Sheep-skins.—The measures advocated for improving the quality of the sheep as meat and wool producers are usually put forward without regard to the value of the skins. The skins are a by-product, with which, as in the case of other hides and skins, only Mohammedans and low-caste Hindus will have anything to do. Moreover, sheep-skins are a much smaller factor than goat-skins in the foreign trade of India. This is especially true of the raw sheep-skins, which occupy quite a minor place in the Indian trade in hides and skins. The exports of raw sheep-skins during the last five years for which returns are available are shown in the following table, together with the average weight of the skins and their average export value per lb. in each year:

Exports of Raw Sheep-skins from India

Year.	Quantity.		Value.	Average weight.	Average value per lb.
	Number.	Weight.			
		Cwts.	£	*lb.*	*d.*
1912–13	2,297,499	31,668	155,285	1·5	10·5
1913–14	2,373,122	33,067	173,999	1·6	11·3
1914–15	1,956,986	26,295	132,355	1·5	10·8
1915–16	2,245,075	32,517	154,438	1·6	10·2
1916–17	2,918,458	45,134	323,968	1·7	15·4

On average, raw sheep-skins are a good deal lighter than goat-skins, but before the war they were worth (export value) from 1*d.* to 1½*d.* per lb. more. Alike in number, total weight, and total value, the exports of raw sheep-skins were increasing before the war. The increase was checked when war broke out, and in 1914–15 the trade declined considerably; but it largely recovered in the following year, while in 1916–17 the returns were far greater than in 1913–14. In percentages of the exports in 1913–14, the exports in the three following years were: in 1914–15, weight 80, value 76; in 1915–16,

weight 98, value 89; in 1916–17, weight 136, value 186. The figures for 1916–17 were not reached in the following year. The available Indian trade returns for 1917–18, under the head of Raw Skins, give particulars only of the goat-skins exported; but the exports of "Other Raw Skins" (which in previous years consisted almost entirely of sheep-skins) amounted to 36,994 cwts. valued at £249,997.

The chief outlet for raw sheep-skins from India is Karachi. In 1912–13, 79 per cent. of the exports of this description were despatched through the ports of Sind, and in 1913–14 the proportion rose to 90 per cent. The rest were divided almost entirely between Bengal and Bombay ports. After the outbreak of war, the share of the trade enjoyed by Sind ports declined, but in 1916–17 nearly 75 per cent. of the exports of raw sheep-skins were still despatched from Sind, while 20 per cent. were despatched from Bombay ports and 5 per cent. from Bengal.

The destinations of the exports, according to the Indian trade returns, were as follows (percentages in italics):

Distribution of Raw Sheep-skins exported from India

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity *cwts.*	31,668	33,067	26,295	32,517	45,134
,, value . .	£155,285	173,999	132,355	154,438	323,968
TO BRITISH COUNTRIES:	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom.	1,081 / *3·4*	1,599 / *4·8*	326 / *1·2*	340 / *1·0*	60 / *0·1*
Others . .	46	340	143	614	622
Total . .	1,127 / *3·6*	1,939 / *5·9*	469 / *1·8*	954 / *2·9*	682 / *1·5*
TO ALLIED COUNTRIES:					
United States .	28,986 / *91·5*	28,818 / *87·2*	24,682 / *93·9*	31,404 / *96·6*	43,704 / *96·8*
Others . .	357	220	156	159	748
Total . .	29,343 / *92·7*	29,038 / *87·8*	24,838 / *94·5*	31,563 / *97·1*	44,452 / *98·5*
TO ENEMY COUNTRIES [1]	740 / *2·3*	1,799 / *5·4*	898 / *3·4*	—	—
TO NEUTRAL COUNTRIES [2]	458 / *1·4*	291 / *0·9*	90 / *0·3*	—	—

[1] *Almost exclusively Germany.* [2] *Almost exclusively Holland.*

The controlling factor in this trade has been the United States; before the war about nine-tenths of the exports of raw sheep-skins from India were consigned there. The exports to the United Kingdom are normally small in themselves and small in comparison with the imports of such skins into the United Kingdom from other sources. In the Indian trade returns no distinction is made between the different classes of raw sheep-skins which are exported; but the *Annual Statement of the Trade of the United Kingdom* gives separate returns for woolled skins—that is, skins from which the wool has not been removed—and pickled skins. As the former are reckoned by weight and the latter by number, direct comparison of quantities is impossible; but the value of the United Kingdom imports of woolled skins is normally about three times that of the pickled skins. Between one-third and one-half of the woolled skins are re-exported normally, and a much larger proportion of the pickled skins. The following table gives the figures for five years:

United Kingdom Trade in Raw Sheep-skins (Foreign and Colonial Merchandise)

A.—Woolled

Imports from	1912. lb.	1913. lb.	1914. lb.	1915. lb.	1916. lb.
British India .	171,201	641,649	364,479	608,092	1,156,550
Other countries[1]	77,840,000	81,620,595	71,017,464	86,810,405	51,216,225
Total Imports	78,011,201	82,262,244	71,381,943	87,418,497	52,372,775
Re-exports .	36,680,432	34,990,043	23,834,070	26,747,186	15,378,041
Net Imports .	41,330,769	47,272,201	47,547,873	60,671,311	36,994,734

B.—Pickled

Imports from	1912. Number.	1913. Number.	1914. Number.	1915. Number.	1916. Number.
British India .	34,275	65,088	80,598	96,006	70,150
Other countries[2]	8,350,561	7,468,710	6,344,310	8,834,097	4,785,923
Total Imports	8,384,836	7,533,798	6,424,908	8,930,103	4,856,073
Re-exports .	6,122,934	6,716,190	5,814,179	7,774,649	5,009,263
Net Imports .	2,261,902	817,608	610,729	1,155,454	*

* Excess of re-exports over imports, 153,190 skins.

[1] *Chiefly Australia and South Africa, with New Zealand third, but a long way behind.*

[2] *Chiefly New Zealand (normally three-fourths of the total).*

Though India plays so small a part in these returns, they are not without instruction in the present study of the Indian trade in hides and skins. They show clearly that under pre-war conditions there was no great industrial demand in the United Kingdom for pickled sheep-skins, and that though considerable quantities of woolled sheep-skins were absorbed, the demand was more than met from other countries than India, chiefly British. In the re-export trade from the United Kingdom, the best customer for the woolled skins before the war was France (between 40 and 50 per cent.), followed by the United States (between 25 and 35 per cent.). Of the pickled skins re-exported, over 85 per cent. went to the United States.

Tanned Sheep-skins.—As previously indicated, one distinguishing characteristic of the Indian trade in sheep-skins, as compared with the trade in hides and goat-skins, is that the exports of tanned sheep-skins exceed the exports of raw sheep-skins in both quantity and value. The number, weight, and value of the tanned sheep-skins exported, with the average weight per skin and the average price per lb., are given in the following table for the last six years :

Exports of Tanned Sheep-skins from India

Year.	Quantity.		Value.	Average weight.	Average value per lb.
	Number.	Weight.			
		Cwts.	£	*lb.*	*d.*
1912–13 .	9,701,682	60,355	776,893	0·70	27·6
1913–14 .	8,119,205	49,652	639,000	0·68	27·6
1914–15 .	7,512,804	45,978	588,965	0·69	27·4
1915–16 .	8,219,040	49,345	658,478	0·67	28·6
1916–17 .	11,172,365	66,254	1,400,686	0·66	45·3
1917–18 .	—	15,895	458,630	—	61·8

In 1912–13 the tanned sheep-skins exported were between four and five times as numerous as the raw skins, nearly twice as weighty, and five times as valuable. In 1913–14, the tanned skins were about 50 per cent. greater than the raw skins by weight. These comparisons relate to totals. The average weight of the

tanned skins is less than half that of the raw skins, while the average price per lb. (export value) is normally between two and three times that of the raw skins. As in the case of goat-skins, the values of the raw and tanned sheep-skins are much more nearly equal *per skin*. Indeed, tanning adds very little to the value of the sheep-skins normally. Thus in 1913–14, while the average value of the raw sheep-skins exported was 17·6*d*. per skin, that of the tanned sheep-skins was only 18·9*d*. per skin. Neither in 1914–15 nor in 1915–16 did the total exports of tanned sheep-skins show any very striking variation from the total in the latest pre-war year, 1913–14; but in 1916–17 the exports were greater in weight than they had been for some years before the war, and with a big increase in prices the total value exceeded £1,400,000. The sudden drop in 1917–18 is explained by the Government restrictions on the tanning and export of skins. In percentages of the exports in 1913–14 the exports in the four following years were: in 1914–15, weight 93, value 92; in 1915–16, weight 99, value 103; in 1916–17, weight 133, value 219; in 1917–18, weight 32, value 72.

Usually between 80 and 90 per cent. of the exports of tanned sheep-skins are despatched from the Madras Presidency (78 per cent. in 1916–17), and most of the remainder from Bombay. The Madras *Handbook of Commercial Information*, commenting on the provincial trade in sheep-skins, says that the raw skins are available all the year round, and the supply would be large if the demand existed; but as a rule it is found to pay better to tan the skins. Tanned sheep-skins are important chiefly in the Ceded Districts, Mysore and Coimbatore. Of the provincial exports, 94 per cent. are despatched from the port of Madras, and 6 per cent. from Tuticorin. They are packed in pressed bales of from 500 lb. to 600 lb. net, wrapped in gunnies and roped.

The destinations of the total exports from India, as given in the Indian trade returns, are shown in the following table (percentages in italics):

Distribution of the Exports of Tanned Sheep-skins from India

	1912–13.	1913–14.	1914–15.	1915–16.	1916–17.
Total quantity . *cwts.*	60,355	49,652	45,978	49,345	66,254
,, value . . £	776,893	639,000	588,965	658,478	1,400,686
To British Countries:	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
United Kingdom .	34,944 / *57·9*	29,202 / *58·8*	29,180 / *63·5*	31,553 / *63·9*	41,623 / *62·8*
Straits Settlements	2,469	1,718	1,766	1,771	1,738
Other countries .	312	511	256	387	119
Total . .	37,725 / *62·5*	31,431 / *63·3*	31,202 / *67·9*	33,711 / *68·3*	43,608 / *65·8*
To Allied Countries:					
United States .	13,382 / *22·2*	10,365 / *20·9*	6,209 / *13·5*	9,770 / *19·8*	16,066 / *24·2*
Japan . . .	9,129 / *15·1*	7,459 / *15·0*	8,424 / *18·3*	5,803 / *11·8*	6,428 / *9·7*
Other countries .	79	280	91	41	152
Total . .	22,590 / *37·4*	18,104 / *36·5*	14,724 / *32·0*	15,614 / *31·6*	22,646 / *34·2*
To Enemy Countries	11	117	48	—	—
To Neutral Countries	29	—	4	20	—

Practically all the tanned sheep-skins exported from India were despatched, even before the war, either to other British countries or to countries now among the Allies. The proportion consigned to the United Kingdom was not so large as in the case of tanned kips, tanned buffalo-hides, and tanned goat-skins; none the less it amounted to three-fifths of the total. The remainder went chiefly to the United States and Japan. Up to and including 1916–17, the distribution underwent little change during the war.

Undressed (rough tanned) sheep-skins figured in the United Kingdom trade returns as a separate entry for the first time in 1913. In that year India contributed 44 per cent. of the total imports of such skins into the United Kingdom; but 56 per cent. of the total were re-exported. During the war a much larger proportion of the imports has been retained. The following are the figures for 1913 and subsequent years:

United Kingdom Trade in Rough Tanned Sheep-skins (Foreign and Colonial Merchandise)

Imports from	1913. Cwts.	1914. Cwts.	1915. Cwts.	1916. Cwts.	1917. Cwts.
British India . .	39,253	28,764	32,946	45,186	—
Other countries . .	49,393	45,888	57,370	26,978	—
Total Imports .	88,646	74,652	90,316	72,164	47,945
Re-exports . .	49,938	29,087	9,994	35,501	14,158
Net Imports . .	38,708	45,565	80,322	36,663	33,787

Of the re-exports in 1913, Germany took 18,669 cwts. (37 per cent.), Austria-Hungary 9,569 cwts. (19 per cent.), and the United States 14,138 cwts. (28 per cent.); together these three countries took 84 per cent. of the total, and the remainder went almost entirely to the Netherlands and other foreign countries. During the war the re-exports have gone almost entirely to the United States.

East India tanned sheep-skins are suitable not only for the manufacture of fancy articles but for roller leather, which is used largely in cotton-spinning machinery for covering small rollers over which the cotton-thread is drawn. They are also suitable for currying purposes, for light-boot upper-work.

NOTES

Map and Diagrams of the Chief Metal Resources of the Empire.—This publication, prepared at the Imperial Institute with the advice of the Imperial Institute Committee on Mineral Resources, is now issued. The chief British countries of occurrence and production of the principal minerals are shown on the map. The diagrams give the outputs of these countries for 1915 in relation to the production of other countries of the world. The metals dealt with are: gold, silver, platinum, copper, tin, lead, zinc, antimony, aluminium, bismuth, iron, manganese, chromium, nickel, tungsten, molybdenum, vanadium and mercury.

The map and diagrams are mounted on linen and folded. The publication is obtainable from the Imperial Institute, price 5*s.* 6*d.* (post free).

The Imperial Institute and the Mineral Resources of the Empire.—The following leading article appeared in the *Madras Weekly Mail* for April 26, 1918:

"The BULLETIN OF THE IMPERIAL INSTITUTE for the

quarter July—September 1917, received by the last mail, contains a special article on the constitution and work of the Institute with reference to the mineral resources of the Empire.

"A brief account is given in the article of the constitution of the Institute and the various legislative measures which have been passed to put its control and management on a basis which will secure its functions being properly carried out. The latest of these was a couple of years ago, and our readers may remember the temporary excitement caused in India by the announcement that its management would in future be vested in the Secretary of State for the Colonies. The perturbation did not last long, however, for the reassuring news was received that the governing body would contain representatives of the Government at Home as well as the Dominions, India and the Colonies. We know now that any idea that was entertained that this transfer of management would entail greater interest being displayed in the resources of the Dominions and Colonies at the expense of India was quite erroneous.

"The publications of the Institute and the periodical bulletins of progress prove that India receives just as much attention as any other part of the Empire. Scarcely a bulletin reaches us in which we are not able to find some record of investigations carried out, enquiries made, advice given regarding the value and commercial possibilities of one or other of India's industries and products, especially those recently discovered or previously overlooked, in which further development may give desirable results. For instance it does not require a very extensive knowledge of Indian commerce, industries and products to realise the potential value of the country as a source of mineral wealth, especially of those rarer minerals the chief value of which lies in their adaptation to the improvement of existing industries. When we consider the size of the Empire, it is not surprising that most of these minerals are found in one part of it or another. What has always been surprising, however, is the way in which this knowledge has been foolishly, almost contemptuously, ignored, and the development of these resources and the profit to be derived from them has been allowed to fall into the hands of a people who have been for many years our keenest and most unscrupulous commercial rivals and are now our declared relentless enemies. The pitiful thing about the whole business is the way in which this criminal neglect has allowed Germany from the very beginning to have the upper hand in the matter of muni-

tions and offensive material in this most devastating war. British neglect has caused us to lumber along in the rear, endeavouring to make up leeway.

" It is a painful subject and has frequently and regretfully been dealt with in the past, and there is little to be gained now by further lamentation. The fact, however, is evident in this article in the BULLETIN under review. We have had proof of it in India in connection with the Burma wolfram industry and that of monazite in Travancore, and similar instances abound in other parts of the Dominions, particularly Australia. The mention of wolfram reminds us that almost all the ores required for the manufacture of " high speed " steels, which are of such outstanding importance in modern engineering, are more or less monopolies of the British Empire, yet Great Britain has been supinely content to get her supplies of alloys of titanium, tantalum, tungsten, molybdenum, etc., from Germany, France and the United States. It passes comprehension now, but the fact remains. Take, next, the case of monazite. Until a few years ago the sole source of thorium, the most valuable constituent of this mineral, was Brazil, but it was controlled by a German syndicate. Now the most important source of supply is the Travancore deposits, and we know the efforts that were made to secure German control of these. Since then more or less important discoveries of monazite, thanks mainly to the efforts of the Institute, have been made in Ceylon, the Malay Peninsula, Nyasaland, Northern Nigeria and elsewhere. The beach deposits of monazite sand in Ceylon will form a very useful addition to existing sources of supply. It may here be mentioned that in the new mineral thorianite, recently discovered in Ceylon, we have one of the ores richest in its content of thorium, the principal and most essential ingredient in the manufacture of gas mantles, etc.

" Returning for a moment to the manganese group of ores, we know that India and other parts of the Empire are particularly rich in the supply of manganese, yet the special manganese used for the manufacture of dry electrical batteries was the monopoly of Germany. Since the outbreak of the war there has been much groping after the specification of the ore used for this purpose, a trade secret which Germany refused to part with. Another mineral which in pre-war days was procured solely from Germany is diatomite, which is largely used as a filtering medium. The sources of supply here too were entirely British, and include the United Kingdom, East Africa, Canada and Australia. The best came from the last-

mentioned place. A grade of diatomite ore useful for the making of dynamite has also been discovered in Canada and Australia. The bauxite deposits of the Central Provinces in India also promise a brighter future for the British production of aluminium."

South African Beans and Peas.—In an article entitled "The Peas and Beans of Commerce" which appeared in a recent issue of this BULLETIN (1917, **15**, 503) some account is given of the principal sources whence the United Kingdom derives its supplies of beans and peas intended for human consumption and also for feeding animals. Since that article was published the Imperial Institute has received from the London Corn Trade Association a collection of samples representing the peas and beans which are now being imported into the United Kingdom in considerable quantities from South Africa.

The following is a list of the various kinds of beans represented:

Butter Beans.—Long, oval, or kidney-shaped, 1 in. long by ½ in. broad, glossy ivory-white.

Large White Haricots.—Long, narrow, oval, ¾ in. long by ¼ in. broad, ivory-white.

Small White Haricots.—Similar to the preceding, but smaller.

Rose Cocos.—Oval or kidney-shaped, ½ to ¾ in. long by ¼ to ½ in. broad, buff ground-colour streaked and mottled with rose, hilum (eye) white outlined with brown.

Painted Ladies.—Plump, oval, about ½ in. long by ⅜ in. broad, distinctly marked, one half ivory-white, the other pinkish-buff speckled with rose.

Yellow Sugar Beans.—Plump, oval, about ½ in. long by ⅜ in. broad, pale buff yellow with a dark stain round the hilum.

Brown Sugar Beans.—Similar to the preceding, of a light coffee-brown colour with a deeper tint round the hilum.

Brown Beans.—Similar to the preceding but slightly longer and of a deeper tint of brown.

Kidney Beans.—Kidney-shaped, ¾ in. long by ½ in. broad, greyish buff with a deeper tint round the hilum.

Small Salmon Beans.—Flat, oval or kidney-shaped, from ½ to ¾ in. long by about ¼ in. broad, light buff suffused with pink.

Canadian Wonder.—Long, kidney-shaped, ¾ in. long by ½ in. broad, of a uniform dark purple.

French Beans.—Long, narrow, about ½ in. long by ¼ in. broad, deep purple speckled with buff.

Red Beans.—Flat, kidney-shaped, ¾ in. long by ⅝ in. broad, purplish-rose ground spotted and streaked with dark purple.

Mont d'Or.—Plump, oval, ½ in. long by ⅜ in. broad, ivory white with irregular black blotches round the hilum.

All these beans are varieties of *Phaseolus vulgaris*, or true haricots, and most of them are well-known market kinds. In addition to the haricots was a sample labelled "Jugo beans," which consisted of the seeds of *Voandzeia subterranea*, the Bambarra ground nut (see this BULLETIN, 1912, **10**, 235).

Three samples of peas (*Pisum sativum*) were also received, comprising white peas, green peas, and a mixed sample of white and green kinds.

At the present time there is a large market in the United Kingdom for pulses of the kinds represented by these samples, provided they are of good and uniform quality. There is, however, no market for mixed beans for human consumption, and considerable expense and loss of time are involved in sorting and grading mixed samples for sale in this country. Complaints have been made by importers that several shipments of mixed beans have recently been received from South Africa. Samples of two such shipments have been forwarded to the Imperial Institute and have been found to consist of a mixture of white and coloured beans of *Phaseolus vulgaris* in about equal proportions. The white beans contained a considerable percentage of shrivelled and discoloured beans, but the coloured kinds with which they were mixed were of good quality.

The need for sorting and grading these mixed beans in South Africa before they are shipped is clearly illustrated by these two samples, both of which contain a large proportion of low-grade beans which are not worth freight charges and should be eliminated from consignments. White beans intended for human consumption should be of plump appearance and of good colour and should be graded according to size, each grade consisting of beans of an even size. Coloured beans should be separated from white beans and sorted according to variety, each variety being marketed under its distinctive name. The different varieties of beans should be grown separately and kept separate for shipment. Once they are mixed, sorting and grading is best accomplished by hand-picking.

A set of standard samples of beans prepared by the

London Corn Trade Association has been sent to South Africa, and it is important that future consignments should conform to these samples, each quality being shipped under its own distinctive mark. At present shippers frequently forward various qualities under one mark, a practice which entails careful sorting and sampling on arrival here with consequent delay and expense.

Fiji Bay Oil.—In this BULLETIN (1916, **14**, 295) reference was made to the bay oil industry of the West Indies, and it was pointed out that the industry might well be extended if oil of a reliable and uniform quality could be produced in regular quantities.

It has been pointed out in the *Kew Bulletin* (1918, No. 4, p. 158) that the production of such oil has been rendered difficult by the fact that the leaves of the true bay tree (*Pimenta acris*, Kostel.) are frequently mixed with those of two other forms which are so similar in appearance as to be practically indistinguishable. These two forms are known as " Bois d'Inde Citronelle " (*Pimenta acris* var. *citrifolia*) and " Bois d'Inde Anise " which does not seem to have been distinguished botanically. The oil obtained from the leaves of " Bois d'Inde Citronelle " has a lemon-like odour owing to the presence of citral, and that of the " Bois d'Inde Anise " is equally undesirable, and reduces the value of any bay oil in which it may be present. It is suggested that in bringing the bay tree under cultivation, care should be taken to ensure that the plants are selected from a pure stock of the true *Pimenta acris*, Kostel.

In connection with this question, it may be mentioned that in 1909 a sample of bay oil was received at the Imperial Institute from Fiji which differed considerably from ordinary commercial bay oil and could not be sold as such in the European market. The oil was pale brown and had the characteristic odour of bay oil with, in addition, a distinct anise-like odour. On examination, it furnished the following constants: specific gravity at 15° C., 0·961; optical rotation in 100 mm. tube at 20° C., − 1° 58′. The oil was soluble in its own volume or more of 90 per cent. alcohol and contained only 23 per cent. of phenols instead of the 60 per cent. found in good bay oil and was unusually rich in methyl ethers.

In view of the note in the *Kew Bulletin* referred to above, it now seems probable that the Fiji sample consisted of oil derived from the leaves of the form of *Pimenta acris* known as " Bois d'Inde Anise."

Empire-grown Sugar.—The *Journal of the Royal Society*

of Arts (1918, **66**, 473) contains a paper by Mr. George Martineau, C.B., entitled "Sugar from Several Points of View," which gives a short historical review of the sugar industry. In connection with the rise of the beet-sugar industry, it is pointed out that Germany supplied the necessary stimulus to the cultivation, by levying a duty, not on the sugar produced, but on the roots. The farmer was thus encouraged to produce the richest possible roots, and the manufacturer to extract the maximum quantity of sugar. This policy resulted in the amount of sugar in the roots being increased from 6 per cent. at the beginning to an average of 17·63 per cent. for the whole of Germany in 1908. Reference is made to the invention of the diffusion process of extraction which was another result of the stimulus, the invention of the multiple evaporator, and the development of the double carbonatation process. In consequence of these great advances in the beet-sugar industry, rapid improvements were made in connection with the production of cane-sugar. The multiple evaporator was adopted and many other improvements were introduced into the mills, thus effecting great reduction in the cost of production. These facts are regarded by the author as proving "that nascent industries can be encouraged, research stimulated, and efficiency created, by a rational, well-regulated, but moderate stimulus."

With regard to the cane-sugar industry, it is recalled that the United States of America give preferential treatment in their own markets to sugar produced in their own territories, and also give a slight preference to Cuba. The effect of this preference enabled the Cuba sugar industry to recover from the effects of the Spanish-American war, and to increase its production until in 1903 it again reached the level of the output in 1894 and 1895, viz. about 1,000,000 tons per annum. In 1913, Cuba produced 2,500,000 tons, and last year no less than 3,000,000 tons. The effect of preferential treatment in the home market has also caused enormous increases in sugar production in Louisiana, Hawaii, Porto Rico, and the Philippine Islands, with the result that the United States, with the help of Cuba, now produces enough sugar for the whole of its own consumption. The author considers "that preferential treatment in home markets is the best and perhaps the only way to give real confidence to capital; and that with that confidence, coupled, of course, with favourable natural conditions, British industries will flourish and may even become capable of furnishing the whole consumption of the Empire."

RECENT PROGRESS IN AGRICULTURE AND THE DEVELOPMENT OF NATURAL RESOURCES

In this section of the BULLETIN *a summary is given of the contents of the more important papers and reports received during the preceding quarter, in so far as these relate to tropical agriculture and the utilisation of the natural resources of the Colonies, India and the Tropics generally. It must be understood that the Imperial Institute accepts no responsibility for the opinions expressed in the papers and reports summarised.*

AGRICULTURE

FOODSTUFFS AND FODDERS

Dried Yeast.—Experiments have been carried out at the Manor Farm, Garforth, on the digestibility of dried yeast when fed to sheep, and the results are recorded in a paper by Charles Crowther and Herbert E. Woodman in the *Journ. Agric. Sci.* (1917, **8**, 448). It was found during the course of the trial that the dried yeast being used contained only 32·5 per cent. of proteins, whereas the dried yeast on the market contains, on the average, about 45 per cent. It is considered, however, that in spite of this the results may be regarded as of general applicability. The average percentage digestion coefficients obtained from the experiments were as follows: total dry matter, 87·5; organic matter, 90·3; ash (sand-free), 63·4; crude protein, 88·1; true protein, 87·9; nitrogen-free extract, 94·5. The digestibility of the ether extract (oil) and crude fibre of the yeast could not be determined owing to the small proportions of these ingredients present. The results indicate that dried yeast compares favourably with the most highly digestible foods used in farm practice.

Palm-kernel and other Feeding Cakes.—From time to time statements have been made to the effect that palm kernel, coconut and ground-nut cakes deteriorate on keeping and soon become rancid. In order to test the validity of this contention, an investigation of the comparative keeping properties of these and other oil-cakes has been made by William Godden, of the Department of Agriculture, Leeds University, and the results have been published in the *Journ. Agric. Sci.* (1917, **8**, 419). Samples of palm-kernel, coconut, ground-nut, linseed, undecorticated cotton-seed, "soycot" and soya cakes were kept (1) in a cake store under ordinary farm conditions; and (2) in the laboratory in a moist state at 37° C., which conditions were regarded as those most

likely to promote decomposition. The results showed that in keeping properties palm-kernel cake compares favourably with most of the oil-cakes commonly used on the farm. The only change which occurs during storage under ordinary farm conditions is an increase in the percentage of free fatty acids of the oil, and this change was found to be common to all the oil-cakes examined. In the laboratory experiments, only four of the cakes, viz. cotton-seed, ground nut, "soycot" and soya cakes, showed any marked development of moulds. It was found that the growth of moulds is always accompanied by loss of organic matter, this loss being divided between the oil and the soluble carbohydrates of the cake. No mould appeared on cakes from which the oil had been previously extracted. The conclusion is drawn that oil-cakes must be kept in dry storage in order to prevent the formation of moulds and the consequent loss of organic matter; if kept under very damp conditions a serious reduction in the oil-content may take place.

In view of the scantiness of information on the digestibility of palm-kernel cake and meal, feeding experiments with sheep have been carried out at the Manor Farm, Garforth, by Charles Crowther and Herbert E. Woodman, of the Institute for Research in Animal Nutrition of Leeds University, and an account of the investigation has been published in the *Journ. Agric. Sci.* (1917, **8**, 429). In order to obtain a direct comparison of the palm-kernel products with some feeding-stuff of similar composition and widely used in farm practice, the digestibility of a sample of undecorticated cotton-seed cake made from Egyptian cotton seed was included. The average digestion coefficients of the two cakes and the meal were found to be as follows:

	Undecorticated Cotton-seed Cake.	Palm-kernel Cake.	Extracted Palm-kernel Meal.
	Per cent.	*Per cent.*	*Per cent.*
Organic matter	58·0	70·8	76·7
Crude protein	67·4	75·4	79·2
" " (corrected for "metabolic protein" in fæces)	74·7	88·5	90·0
Ether extract (oil)	(100?)	98·2	96·3
Nitrogen-free extract	62·0	78·6	86·0
Crude fibre	34·6	20·6	44·8

It is evident from these figures that the cotton-seed cake compares very unfavourably with the palm-kernel cake and meal. By applying these coefficients to the composition of each feeding-stuff as determined by analysis, the following percentages of digestible ingredients were obtained:

		Undecorticated Cotton-seed Cake.	Palm-kernel Cake.	Extracted Palm-kernel Meal.
Organic matter . .	*per cent.*	48·2	60·0	64·9
Crude protein . .	,,	16·6	15·4	16·9
Ether extract (oil) .	,,	4·5 (est.)	8·8	2·0
Nitrogen-free extract .	,,	20·7	35·1	40·7
Crude fibre . .	,,	7·9	2·8	7·3
Food units		81·4	98·4	95·2
Starch equivalent (Kellner) . .		46·2	73·6	68·7

The " food units " in this table are calculated by the conventional expression and are designed to furnish a measure of the relative money values of the feeding-stuffs, whilst the starch equivalents give a measure of their feeding value when added to a maintenance ration. These data indicate that, for the samples of feeding-stuffs used in the experiments, the palm-kernel cake was a little superior to the meal both in money value and in feeding value, whilst its superiority over the cotton-seed cake was roughly 20 per cent. in money value and 60 per cent. in feeding value.

Sugar.—An interesting account of scientific progress in sugar cultivation and manufacture in Java during the last three years has been contributed by H. C. Prinsen Geerligs, Ph.D., to the *International Sugar Journal* (1918, **20,** 60). The crops of 1914 and 1915 were very unsatisfactory owing to protracted drought in the vegetative periods, and the poor results obtained were attributed by some to lack of efforts to control diseases and insect pests and to the degeneration of the sugar-cane. The increased prevalence of diseases and pests was, however, really due to the unfavourable weather conditions, and it is evident that no great deterioration of the cane had taken place as although the cane was not replaced by any other variety the crops of 1916 and 1917 showed a decided improvement. In the latter year, although the area planted (about 394,350 acres) was little greater than that of 1916 (371,954 acres), the estimated production of cane was 1,800,000 tons or 10,167 lb. per acre, as compared with 1,299,272 tons or 7,786 lb. per acre in 1915. The better results of 1916 and 1917 were, however, not entirely due to the better weather, but also to the greater care bestowed on the planting material, the planters having to a large extent returned to the old method of planting nursery fields for tops in favourably situated localities.

Endeavours are being made to raise new varieties of cane, and the Experiment Station is now growing seedling canes on Mendelian principles and carefully recording the progress of the experiments, so that if a really superior

cane is produced and should subsequently lose its qualities, it may be possible to reproduce it by following out the plan by which it was originally obtained.

Owing to the difficulty of obtaining sulphate of ammonia which was formerly the most generally used manure in Java, the planters are now employing Chili nitrate and organic manures, such as castor cake, ground-nut cake, and bat's dung, and these have been found to give good results.

The Java sugar industry is having to contend with serious difficulties in connection with transport, and one million tons of the 1916–17 crop are still awaiting shipment. The problems involved in the storage of such large quantities of sugar have been energetically studied, and it is anticipated that every precaution will be taken to maintain the quality of the sugar until transport facilities become normal again.

Wheat.—A special Committee has been appointed by the Advisory Council of Science and Industry, Commonwealth of Australia, to investigate the damage caused by grain weevils and other pests to wheat in store. This Committee has issued a progress report on the subject of grain weevils which has been published in *Bulletin* No. 5 of the Advisory Council, entitled "Problems of Wheat-Storage." This Bulletin also contains a report of a Committee which was appointed to investigate the effect of quick-lime on wheat.

In the latter report, an account is given of a series of experiments which have been carried out with the object of investigating the following proposals made by Mr. A. O. Barrett for the purification of wheat by treatment with lime. The wheat after being screened to free it from foreign matter is mixed with 1 per cent. of its weight of hot, freshly burned quick-lime and transferred to a suitably situated large basin silo, built of brick or cement work, with a hopper-bottomed asphalt flooring. The wheat should be stored in this silo until required for use. It would then be freed from lime by passing it through suction and sifting machinery. The wheat to be treated in this way is such as has been attacked by weevils or mice, or damaged by damp, etc.

The experiments have led to the following conclusions. When wheat is treated in the manner described, the bacteria on the outer layers of the grains are considerably reduced in number, and the surface is slightly corroded and cleansed from organic nitrogenous compounds. When wetted, the treated wheat turns distinctly yellow although

all the free lime has apparently been removed by screening. With f.a.q. wheat, the effect is to facilitate the process of tempering and to improve the quality of the bread baked from the flour. In testing the effect of the lime treatment on weevils it was not practicable to arrange for the addition of hot lime on a small scale, but it was found that treatment with cold lime does not immediately kill the fully grown insects, nor does it prevent the eggs from hatching. Damaged wheat is not rendered wholesome if the grains are rotted throughout, but further deterioration is checked. In the case of mousey-tainted wheat, the taint is removed, and the grain, if not otherwise deteriorated, can be used for bread-making. It has been found that the degree of contamination or deterioration of wheat is indicated by the ammonium content of the extract obtained by soaking the wheat in water; the damaged samples used in the experiments were found to yield from eight to twelve times as much ammonia as the clean wheats. The Committee recommend that the method of treating wheat with lime and storing it in large basin silos should be given a trial.

Limes.—Considerable progress is being made in the cultivation of limes in Grenada (*Rep. Agric. Dept., Grenada*, 1916–17). The total area devoted to limes is 1,124 acres, of which 533 acres are situated in Grenada and 591 acres in Carriacou. In 1916, the exports of lime products amounted to 150,525 gallons of raw juice and 7,500 gallons of concentrated juice. The crops of the years 1914–1916, expressed in terms of barrels of fruit, were as follows: 1914, 2,684; 1915, 8,396; 1916, 27,265. The Department of Agriculture have continued to encourage the industry by the propagation and distribution of plants and by educational methods, and further extension of the industry is anticipated.

Oils and Oil Seeds

Aleurites Species.—Wood oil (tung oil) obtained from seed grown in the United States of America has been examined and found to be equal in quality to the best imported Chinese wood oil (*Oil and Colour Trades Journ.*, 1918, Jan. 12, p. 123). In the case of two samples of seed grown in California, however, the oil was of abnormal character, which is thought to be due to the climatic conditions under which the plants were grown.

Castor Seed.—Owing to the use of castor oil as a lubricant for aeroplane engines, an enormous demand

has arisen for castor seed, and efforts are being made in many countries to increase the cultivation of this crop. As the castor plant thrives in Algeria, an extension of cultivation is recommended and a general description of the method of cultivation is given in a recent number of the *Bulletin du Gouvernement général d'Algérie* (1917, **23**, 186).

The castor plant flourishes as a weed in the São Paulo district of Brazil and small quantities of oil have been produced in the local mills (*U.S. Commerce Repts.*, 1917, No. 273, p. 711). American buyers are importing seed from São Paulo and the newly established oil mill (see p. 252) is endeavouring to obtain machinery from the United States for crushing castor seed.

In Trinidad the extension of cultivation is also recommended and an American firm is stated to have placed orders for 500 tons of seed (*Trinidad Guardian*, Nov. 9 and 10, 1917).

Coconuts.—Much of the copra produced in the Philippine Islands is of poor quality owing to imperfect methods of drying. Brill, Parker and Yates have investigated the various factors causing inferiority of copra and have suggested methods for improving the quality (*Phil. Journ. Sci.*, Section A, 1917, **12**, 55). Unless dried so as to contain not more than 6 per cent. of moisture, the copra is attacked by various micro-organisms which cause loss of oil and heating of the copra in store or during shipment. Philippine copra is dried either in the sun or by means of a "tapahan" or crude native kiln; mechanical driers would probably solve the difficulty of drying copra, but their cost and the expense of working are generally too great to allow of their adoption; the authors consider that a small cheap mechanical drier capable of drying copra rapidly and cheaply would find a ready market in the Philippines. The Bureau of Science has devised a method of treating copra with sulphur dioxide gas before drying, whereby the copra produced by subsequent drying without artificial heat is white and free from mould, and is said to yield oil of excellent quality.

In the same journal (p. 87) Parker and Brill describe the Filipino method of preparing coconut oil; this consists in grating the fresh meat, which is then steamed and packed in rattan bags, the oil being expressed by means of a wooden screw press; the emulsion of oil, water and cellular tissue is separated by heating. The oil obtained by the first pressing of the fresh meat amounts to about one-third of the total oil, and is used as edible oil.

Further quantities of oil are then obtained from the meat by allowing it to ferment and again pressing it; this oil is of poor quality, and is used for soap making. The authors have attempted to devise improved methods of oil preparation, and state that oil of good quality can be obtained by grinding the fresh meat, followed by drying the ground-up meat at 70–85° C. on trays, and by expression of the oil. No details of the small experimental drying machine used are given, but it is stated that the amount of moisture in the ground-up meat was reduced to 10 per cent. in an hour, and on pressing once 80 per cent. of the total oil was obtained. Although the method appears not to be suitable for native use on a small scale, it possesses the advantages of avoiding handling of the material, producing good oil and a clean residual cake suitable for use as human food, and the authors consider there should be an opening for a plant to produce edible oil and press cake for human food.

The most destructive insect enemy of the coconut palm in Panama is the larva of *Brassolis isthmia* (*Rev. Applied Entomology*, 1918, **6**, Ser. A, p. 19). Spraying is unsatisfactory as a remedial measure, the only sure method being to collect the nests of larvæ before the latter are fully grown, and destroy them by crushing, burning or dipping in some strong insecticide; this method is troublesome as it necessitates the use of long ladders. Banding the trunks of the trees with tar will prevent young larvæ from reaching the leaves. The pest is destroyed by birds, toads, lizards and ants, and parasitic insects destroy many pupæ after the larvæ have caused damage, while a parasitic fungus also attacks mature larvæ and pupæ.

Cotton Seed.—A good deal of cotton is grown in the São Paulo district of Brazil, but the seed is often damaged by being allowed to lie in heaps unprotected from the weather; farmers are now beginning to realise the value of the seed and an improvement in handling is expected in the immediate future (*U.S. Commerce Repts.*, 1917, No. 273, p. 710). A mill for the manufacture of cotton-seed oil has obtained machinery from the United States and commenced operations; oil said to be equal in quality to the best oil made in the United States is being produced and large shipments have been made to the Argentine. Obstacles to the rapid development of the industry have been the difficulties of collection of seed, and of obtaining materials for making containers for the oil.

Ground Nuts.—Ground nuts grow well in the São Paulo district of Brazil, and it is expected that large quantities

of seed sufficient to supply the recently established oil-mill for six months will be available (*U.S. Commerce Repts.*, 1917, No. 273, p. 710.)

Linseed.—Considerable quantities of flax are grown in the São Paulo District, and preparations are being made to crush the seed for oil (*loc. cit.*).

Para Rubber Seed.—A paper on the oil content, keeping qualities and commercial possibilities of Para rubber seed is contributed by Spring and Day to the *Agric. Bull., Federated Malay States* (1918, **6**, 231). It has been estimated that from 306 to 330 lb. of seed per acre can be obtained annually from rubber estates. The cost of collection still seems to be somewhat uncertain, but six tons of seed were collected on a Selangor estate on behalf of the Agricultural Department at a cost of £11 13s. 4*d.* It is recommended that seed should be collected during the fruiting season once in every two or three weeks, as it does not suffer from lying on the ground for short periods. It is estimated that 427,000 seeds are required to produce one ton of kernels. A series of experiments on the keeping qualities of the seed was carried out; seeds and kernels were stored in sacks and in closed boxes for varying periods of time, after which the seeds were examined and the amounts of moisture, oil and free acid in the oil were determined. The results show that air-dried seed or kernels may be stored in sacks for periods up to six months without appreciable deterioration; storage in boxes is less suitable as the contents were found in many cases to be attacked by mould. These results are in accordance with the earlier results of examination at the Imperial Institute of a consignment of air-dried kernels from Ceylon which were found to be in satisfactory condition on reaching London. With regard to the possible utilisation of the seed and oil the authors quote in full most of the information already published in this BULLETIN (1913, **11**, 551).

Experiments on the expression of Para rubber seed oil are being made on a fair scale in the Federated Malay States and a consignment of 30 tons of seed was sent recently to a firm at Hull. The oil produced sold at £50 per ton when linseed oil was worth £60 per ton, while the residual meal sold at £8 per ton. There can be no doubt therefore that air-dried kernels in good condition, or Para rubber seed oil and meal of good quality would be readily saleable. It only remains to be seen whether owners of rubber estates can organise the collection of

seed so as to place it on the market in sufficiently large and regular supplies to induce oil manufacturers to work this material.

Miscellaneous.—Considerable quantities of tomato seed and skins are obtained as waste products of the canning industry, and the disposal of the waste seed mixed with skin is a matter of some importance as the residue soon becomes offensive. In Italy the seeds have been utilised as a source of oil for some time past, and Rabak discusses the question and describes the processes employed in *Bulletin* 632, 1917, *U.S. Dept. Agric.* The method of recovering the seed consists in drying the residue and separating the seed and skin in sifting and fanning machines. The seed, which contains about 22 per cent. of oil, can then be treated for the recovery of oil by the usual methods of expression and extraction. The oil is liquid and when purified is of pale yellow colour and possesses a bland nut-like taste and smell. In Italy feeding experiments with the residual cake or meal have given satisfactory results; and several grades of cake or meal made in Milan from the seed residue mixed with skins are sold at prices ranging from about £6 to £6 10s. per ton In the United States it is estimated that about 3,390 tons of waste seed and skins are at present produced annually, equivalent to about 343 tons of oil, 1,200 tons of seed meal and 1,800 tons of skins; and as the quantity of waste material is likely to increase in the future, a co-operative system of collection and utilisation seems advisable.

The seeds of *Echinocystis oregana*, a plant widely distributed on the Pacific Coast of North America and commonly known as "wild cucumber," contain 30–35 per cent. of oil similar in character to cotton-seed oil (*Journ. Indust. Eng. Chem.*, 1918, **10**, 126).

Owing to the shortage of oils in Germany, attention has been turned to a number of seeds which can be obtained from indigenous plants or which can be easily grown there (*Int. Rev. Sci. and Practice of Agric.*, 1917, **8**, 1128). Colza (rape) was being cultivated, and of the 642,486 acres of copse available for this crop 86,488 acres were to be used in 1917. The cultivation of sunflowers was still in an experimental stage at the end of 1916. Poppies can only be grown in good well-sheltered soil. The collection of beech nuts has been undertaken, and an estimated yield of about 490,000 tons of nuts yielding 2,200,000 gallons of oil at a cost of 3 marks (3*s.* at par) per gallon was expected. There are few walnuts or hazel nuts available in Germany; horse-

chestnuts only yielded about 5 per cent. of oil, the utilisation of which is still being studied; lime seed yielded only about 2·5 per cent. of oil on expression. Spruce seed yields 25 per cent. of oil, but only about 393 tons were available. It appears that beech-nuts are to be used for the production of oil and cake for human consumption, while horse-chestnuts and acorns are to be reserved for cattle food, their use being regulated by Federal order and their sale controlled by the Sales Union of German farmers at 190 marks and 150 marks per metric ton (dried) respectively.

Rubber

Castilloa.—The special Rubber Committee of The Trinidad and Tobago Department of Agriculture have arrived at the conclusion that the planting of *Castilloa* as a pure crop is unprofitable, and that further planting even as a shade for cocoa is inadvisable except on estates where *Castilloa* has already given good results with cocoa (*Bulletin Dept. Agric., Trinidad,* 1917, **16,** 95). Where *Castilloa* is growing well it will, however, pay to tap it, the most profitable method being to make oblique upward cuts with a cutlass one foot apart on one side of the tree; tapping should be done two or three times a year in dry weather, the rubber being collected in the form of "scrap-ball."

Hevea.—The Report of the proceedings of the First Agricultural Conference, Malaya, held at Kuala Lumpur in April 1917, contains a number of papers dealing with the cultivation, tapping, preparation and pests of Hevea rubber.

The report of the Special Rubber Committee of the Trinidad and Tobago Department of Agriculture, referred to above, also deals with Hevea rubber. On certain plantations the results with Hevea have been equal to those obtained on average estates in the East, and the industry is regarded as worth encouragement in suitable districts. Although rubber is unlikely to become as important a crop as cocoa, sugar or coconuts, it should become one of the most important secondary industries. Trees should be planted not closer than 20 × 20 ft. and thinned out later. Coffee, especially *Coffea robusta,* is considered to be the most suitable intercrop, and cover crops, especially on hilly lands, are desirable to prevent "wash." Experiments have indicated that a tapping interval of four days is most profitable under local con-

ditions, but experiments at lesser intervals are being made. The formation of a local Rubber Planters' Association is recommended, as well as the appointment of a rubber expert with experience in Eastern rubber plantations.

A résumé of the recent work on rubber of the Malay Department of Agriculture is given by Eaton (*Agric. Bulletin F.M.S.*, 1917, **6**, 147). The author considers that the best method of preparing quick-curing "slab" rubber will probably consist in cutting up the matured coagulum into worms, followed by drying in a vacuum or in hot air and pressing into block. In this way the expense of shipping wet slab containing 15–20 per cent. of moisture and therefore requiring washing after export to the rubber mills will be avoided. It has been found that the chromogenic organisms which produce "spots" on rubber retard the rate of cure of quick-curing rubbers produced from matured slab when the rubber is packed loose in a moist condition; if, however, such wet rubber is pressed into a compact block no formation of pigment takes place, whence therefore it appears that the chromogenic organisms attack the substances causing acceleration in rate of cure.

Manihot.—The cultivation of Manihot trees in German East Africa is dealt with in an article by Christy in the *Journ. African Society* (1918, **66**, 113). He considers that the industry is likely to prove of value, but it should perhaps be pointed out that this view is not universal (cf. this BULLETIN, 1914, **12**, 486). Manihot trees have been planted in large numbers in the bush along the railroad from Dar-es-Salaam to Ujiji; the trees are planted 8 ft. apart in rows 10 ft. apart (at the rate of 550 trees per acre). Little previous clearing of bush has been made as the trees soon form a canopy, preventing further growth of grass or bush, and practically nothing is spent on upkeep. Where Manihot has failed to thrive Sisal hemp has been planted. Tapping is cheap and simple, and transport of goods and rubber is easily effected by motor-car along roads between the blocks of rubber trees. Although Manihot trees are inferior to Hevea as a source of rubber, and do not yield an increased return as the tree grows older, Manihot can be tapped when about two years old, so that the older trees which become unproductive owing to thickening of bark after five or six years of tapping can be cut out and rapidly replaced. The author considers that under normal conditions the exports of Ceara rubber from German East Africa would have been large and steady.

Balata

An account of the balata industry of Venezuela is given in *U.S. Commerce Reports*, 1917, No. 272, p. 698. The collection of balata commenced near Maturin, but in 1894 the trees in this district had already been exterminated. Exploitation was then carried on near San Felix in the State of Bolivar, and extended eastwards to the British Guiana boundary and southward along the Orinoco and its tributaries. It is estimated that 10,000 collectors have destroyed 36,000,000 trees in the last ten years. Although tapping is enforced in British and Dutch Guiana, and felling of trees is forbidden, regulations to prevent destruction of trees have been opposed in Venezuela. The trees are unproductive during the first ten years of their growth, and only become fully developed in thirty years; natural regeneration is slow owing to the fruits being eaten by wild animals. The collection of balata takes place from May till August, though the trees can be worked at all times during years of continuous rain except when they are flowering, at which period the sap is too weak to render collection remunerative. The average yield of latex per tree is at present 3 gallons, equivalent to 18 lb. of balata, but by proper tapping each tree should produce $2 worth of balata per year for thirty or more years. The exports of balata amounted to 2,219, 894 and 1,096 metric tons in 1913, 1914 and 1915 respectively, while 287 metric tons were exported in the first six months of 1916. Before the war Germany was the principal buyer, followed by France, the United States and the United Kingdom in the order named; in 1916 the United Kingdom and the United States appear to have been the only buyers.

Fibres

Sisal Hemp.—It is stated in the *Rep. Dept. Agric., Antigua*, 1916–17, that a definite start has been made in the island of Antigua in the cultivation of Sisal hemp on a commercial scale. About 8,000 plants have already been set out, arrangements are being made to import large numbers of plants from Anguilla, and it is anticipated that extensive areas will be devoted to the crop. When the plants are sufficiently mature, modern machinery will be imported for extracting the fibre.

Paper-making Materials.—The *Indian Forester* (1917, **43**, 479) contains an article by R. S. Hole, I.F.S., Forest Botanist, on the best method of working "ulla" grass-

lands. In 1910, samples of "ulla" grass (*Anthistiria gigantea*, Cav., sub. sp. *arundinacea*, Hack.) were examined by Raitt, and as an outcome of his report on the value of the material for paper-making it was proposed to establish a paper-pulp factory in the Pilibhit Division of the United Provinces. It therefore became necessary to determine the best method of harvesting the grass in order to obtain a sustained maximum yield per unit area, especially of the flowering culms, which form the most valuable part of the crop in respect of the quantity and quality of pulp produced. At the time of cutting the crop it is usually found that the majority of the culms which would become flowering culms in the succeeding year are present as leafy shoots. If these shoots are cut when the flowering culms are harvested the yield of grass in the next year will be diminished. It is therefore of importance that only the flowering and dead culms should be cut, the leafy culms being spared. It is also pointed out that, according to Raitt, the inclusion of immature leaf in the crop is objectionable from the standpoint of the paper-maker as it causes agglutination and also interferes with the bleaching. Another point which has to be considered in connection with the harvesting of ulla grass is the fact that the dry grass-lands of Pilibhit are very liable to damage by fire. A late fire in April or May is very destructive and burns all the shoots to the ground. Assuming that the fire is unpreventable, the damage could be reduced by burning purposely immediately after cutting. This procedure, however, if continued from year to year would probably cause a diminution in the yield by reducing the quantity of organic matter and moisture in the soil. The effect of fire is also to facilitate the access to the grass-lands of deer and other animals which eat the young shoots and thus increase the damage.

In view of the above facts, experiments have been carried out to determine the comparative merits of the following methods of treating the Pilibhit grass-lands: (1) cutting all shoots, flowering and leafy, and burning the area as soon as possible after cutting; (2) cutting all shoots, flowering and leafy, and then protecting the area from fire; (3) cutting only the flowering and dead shoots and burning as soon as possible after cutting; and (4) cutting only the flowering and dead shoots and then protecting the area from fire. The results obtained are so strongly in favour of treatment (4) that there seems no reason to doubt that this is the best treatment to adopt. It is also suggested that efforts should be made to increase the yield of the grass by improving the fire-protection

arrangements and by increasing the proportion of ulla in the crop by artificial propagation. The experiments are being continued and further trials are being made to ascertain the effect of (1) alternate burning and protection, and (2) alternate complete and partial cutting.

Cotton

Union of South Africa.—Reference was made in this BULLETIN (1917, **15**, 453) to the progress which is being made in cotton growing in South Africa. It has now been stated in the *South African Journal of Industries* (1917, **1**, 175) that the area estimated to be devoted to cotton in the Union during the present season is from 7,000 to 10,000 acres. A number of farmers are planting cotton in Zululand, over 2,000 acres having been sown in one district.

Further information on the subject is given in the *South African Journal of Industries* (1917, **1**, 290, 492, 562). Cotton is being produced on a commercial scale in the Rustenburg and Waterberg Districts of the Transvaal. The cultivation has been carried on for several years in the Zoutpansberg and Pietersburg Districts, but has failed to make proper progress owing chiefly to lack of organisation in ginning and marketing the crop. Cotton has been found to thrive in parts of the Lydenburg, Middelburg and Barberton Districts, but the crop has not proved remunerative in these areas on account of the absence of ginning facilities. In the Lydenburg District, however, a ginnery has now been erected and cotton is being grown on a commercial scale. Swaziland is well adapted for cotton growing, but the industry has been hindered by the lack of transport and ginning facilities. Small areas have been planted in parts of Zululand and Natal during the last few years and have given successful results. In the Transkei and Pondoland, cotton can be grown with success, and, under existing conditions, would doubtless be produced chiefly as a native crop. Five bales of cotton from Pondoland were shipped to Liverpool last March and three of these were sold at 16*d.* per lb. The crop was grown on the banks of the Umzimvubu River, in both light and black soils, the latter yielding the better results. It is not considered likely that cotton growing will be taken up extensively in this district at present, as it is said to yield smaller profits than maize, and the labour supply presents some difficulty.

India.—In the *Rep. Dept. Agric., Punjab*, 1916–17, attention is drawn to the great developments which

have taken place in connection with the cultivation of the American cotton, known as 4F. The area devoted to this variety has increased from 7,700 acres in 1915 to 50,000 acres in 1916, and 215,000 acres in 1917. On by far the greater part of this area (about 90 per cent.) the cotton is grown as a pure crop, but on the remainder the 4F is more or less mixed with native cotton. Efforts are made to keep the cotton pure, but the demand for seed is so great that the Zamindars insist on growing even mixed seed if they cannot obtain supplies of the pure variety. As the 4F cotton commands a premium of about 4 Rs. per maund above the price of the native cotton, it was estimated that the extra profit obtained by the growers of the 4F variety during the winter of 1917 would amount to over £300,000. The American cotton has to be sown early on good land, and the peasant prefers native cotton for his own domestic use. It is therefore considered unlikely that the 4F variety will ever completely displace the native cotton.

An interesting account of the efforts made to improve the cotton-growing industry of Madras is given in the *Rep. Dept. Agric. Madras*, 1916–17. In the "Northerns" and "Westerns" area, 934 acres were sown in 1915 in the Bellary district and 980 acres in the Kurnool district with the selected strains known as Sircar Nos. 1 and 2. The crop was grown under seed-farm conditions and the yield was only about 40 lb. per acre as compared with 50 lb. given by the local cotton. It is therefore evident that more attention must be directed to the yield of lint per acre in making selections for these tracts. Hitherto the strains have been selected mainly for good staple, colour and strength, but to the ryot the yield is the most important consideration as the difference in price between long- and short-stapled cotton is not sufficient to compensate for the poorer yield of the former. In Kurnool, an experiment was made to ascertain whether it would be profitable for a ryot to clean his seed-cotton before selling it, but as a result a considerable loss was sustained as the buying firms refuse to pay any higher price for the clean cotton. It is therefore concluded that the usual practice of selling the good and bad cotton together just as it comes from the field is obviously the best plan in the circumstances.

In the "Tinnevellies" tract, 552 acres were cultivated as seed-farms in 1915 with the varieties known as Company No. 2 and Company No. 3. The average yield of lint per acre was 96 lb. for Company No. 2 and 139 lb. for Company No. 3 for the first picking in each case. A second picking is not taken on these seed-farms, as the seed thus

obtained is not of such good quality. The average yield of unselected Tinnevelly cotton is about 90 lb. per acre, including both pickings. The selected strains thus combine both good yield per acre and good staple. Efforts to restrict the cultivation of the inferior "pulichai" cotton were made by (1) a combination of the buying firms refusing to purchase it, and (2) a distribution of seed of the Company No. 3 variety which gives the grower a better return per acre than "pulichai." As a result, "pulichai" has been largely rooted out, but it still exists as an impurity in the general crop over a wide area. It is considered that it will take years to eliminate it completely, not because it will be grown deliberately, but because many ryots are careless about their seed.

Uganda.—An account of the progress of the cotton industry of Uganda is given in the *Ann. Rep. Dept. Agric., Uganda Protectorate*, 1916–17. It is estimated that 129,833 acres were planted, the whole of the seed sown being of the "Sunflower" variety, and derived from selections made at the Government Plantation at Kadunguru. Owing to the prevalence of wet and cold weather, the yield per acre was the lowest on record, and the crop contained a good deal of stained and immature fibre. Where the crop was successful, however, the cotton showed a distinct improvement, being more regular in staple, stronger, and having a better twist than that of previous years. The crop met with a good demand and realised high prices, especially in the Buganda Province. The exports amounted to 77,691 cwts. of ginned and 32 cwts. of unginned cotton as compared with 91,231 cwts. and 8,110 cwts. respectively in the preceding year. The value of the crop was greater, however, being £348,914 as against £245,426 in the previous year. The cotton was of a high grade and, when marketed in good, clean condition, generally realised 4*d.* or 5*d.* per lb. in advance of the price of "middling" American. The amount of cotton seed exported was 5,460 tons as compared with 5,225 tons in 1915–16. New ginneries have been erected at Kalaki in Lango and Kidongole in Teso, and others are being constructed in various parts of the country. Practically the whole of the cotton is now ginned and baled in the Protectorate.

West Indies.—In a report on the cotton industry of St. Vincent (*Rep. Agric. Dept., St. Vincent*, 1916–17), it is stated that the area devoted to Sea Island cotton in that year was only 2,401 acres, which is the smallest acreage planted since 1906–7. Unfavourable weather

was again experienced with abnormally heavy rains in October and November, and the total estimated yield of cotton was only 160,168 lb. or about 66 lb. per acre. Many of the bolls were affected with disease, especially with internal boll-rot following attacks of the cotton stainer. Energetic measures were taken to control the cotton stainer (compare this BULLETIN, 1918, **16**, 115). Although cotton cultivation has experienced several unfavourable seasons in succession, many planters are resolved to give the industry a further trial in the hope that their efforts may be rewarded by a good season and high prices for the crop. The area cultivated with "Marie Galante" cotton in the Southern Grenadines was 1,050 acres and the yield amounted to 45,852 lb. Sea Island cotton is grown in these islands as well as "Marie Galante" and the acreage devoted to the former is steadily increasing, the Sea Island seed for planting being obtained from St. Vincent. Manurial experiments which have been carried on in St. Vincent at the Government Experiment Station for five years have given the following results. The percentage of flowers which produced ripe bolls was not affected by differences in manurial treatment. All the manured plots showed a larger yield than the unmanured. The most necessary manure for cotton in St. Vincent is potash, the application of which produced a yield of 76 per cent. more than that given by the unmanured plots. An application of phosphate and potash was found to be less beneficial than potash alone. Artificial manures and cotton-seed meal in combination gave better results than either alone. An application of cotton-seed meal at the rate of 600 lb. per acre was apparently insufficient to meet the full requirements of the plants when grown on the same soil for a number of years. These results emphasise the necessity of manuring heavily and adopting a rational system of rotations.

According to the *Rep. Agric. Dept., Montserrat*, 1916–17, the area planted with cotton in that island in 1916–17 was 1,997 acres and the yield amounted to 313,322 lb., or an average of 156 lb. per acre. The season was favourable on the whole and comparatively little damage was caused by the cotton worm. Cotton stainers were not abundant until towards the end of the year, the suppression being effected by collecting the insects by hand when they first made their appearance. The amount of stained cotton in the crop amounted to 7·7 per cent. of the whole. The work carried out at the Experiment Station is leading to the production of a high-grade cotton which realises good prices and to the provision of a reliable supply of